No. 280 DECEMBER 1960 Vol. LXX

# THE ECONOMIC JOURNAL

THE QUARTERLY JOURNAL OF THE ROYAL ECONOMIC SOCIETY

*Edited by* SIR ROY HARROD *and* E. A. G. ROBINSON
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NEW YORK: ST. MARTIN'S PRESS
PRICE TEN SHILLINGS NET

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THE ECONOMIC JOURNAL

*DECEMBER* 1960

# LINEAR THEORY[1]

THE subject which I shall be discussing in this survey concerns the group of techniques—Linear Programming, Activity Analysis, Input–Output and Theory of Games [2]—which have come to us, chiefly from America, during the last fifteen years. It is apparent, from the most casual inspection of these topics, that they are very closely related. Further examination shows that they can be set around a recognisable core, which may be regarded as a restatement of a central part of conventional economic theory. It will be my object, in what follows, to isolate this core; and to consider what there is that the economist, who has no intention of becoming a practitioner of the techniques, may yet have to learn from it.[3]

This being the intention, it will obviously be proper to put what I have to say into a form in which the mathematics are kept down as much as possible; but it is useless to conceal from the reader that we are dealing with a mathematical subject. The phenomenon which we are to examine is the application to economics of a new kind of mathematics. The most obvious difference between this new mathematical economics and the older variety (which goes back to Cournot) lies in the kind of mathematics that is being used.

[1] This is the second of the series of special articles, referred to in the June issue, designed to give a summary of recent developments in economic theory and supported by the Rockefeller Foundation.

[2] I shall have much less to say about game theory than about the others.

[3] My purpose is therefore quite different from that of the numerous text-books which seek to teach the techniques to the practitioners. It is, however, not far from that which might have been expected from the authors of *Linear Programming and Economic Analysis* (Dorfman, Samuelson and Solow); it is certainly true that without their work the present paper could not have been written. My main criticism of their performance is that they did not sufficiently differentiate their task from that of the text-books. I accordingly propose to begin in quite a different way from that in which they begin, though in the latter stages of my work I shall draw on them very heavily. (It would then be a great nuisance not to have a single name for this composite author; I shall make bold to christen him, when I need to do so, DOSSO.)

Reference must also be made to the excellent survey by W. J. Baumol ("Activity Analysis in one Lesson," *A.E.R.*, December 1958). His purpose has been nearer to mine, but I think he would be the first to admit that there is room for both of us.

The text-books from which I have derived most benefit are those of S. Vajda (*Theory of Games and Linear Programming*) and S. I. Gass (*Linear Programming*). Both of these are highly mathematical; but they have helped me to grasp the structure of the theory (with which I shall be largely concerned) more clearly than I could get it elsewhere.

All through the "neo-classical" period—in the age of Marshall, of Pareto, of Wicksell, even in that of Pigou and Keynes—the economist's main mathematical tool was the differential calculus, expressed (when necessary) in the form of symbols, reduced (when possible) to the form of curves. This, of course, was perfectly natural; most economic problems were problems of maxima and minima, and (since the days of Newton and Leibniz) the differential calculus has been the standard method by which such problems had been approached. It has, however, long been known that there are some quite elementary maximum problems (such, for instance, as those concerned with perimeters of triangles) for which the calculus method is not at all well suited; they may, however, give no trouble if they are tackled on an *ad hoc* basis, usually in Euclidean terms. The development of systematic methods for the study of such cases as these has been an object to which, in our time, quite formidable mathematical ability has been devoted. And the new methods, once found, have often proved to be more satisfactory than the old, even in fields where it is possible for both to be applied.[1] The linear theory, which we are to examine, derives much of its character from the fact that it is an application of some of these newer mathematical methods to economics.[2]

So much must be said, even at the start; though it is inevitable that by saying it one raises the suspicion that economics is being used as a mere opportunity for mathematical exercise, valuable enough to the mathematicians who disport themselves upon this parade-ground, but with a marginal product (in terms of the things in which economists are interested) that is, after all, infinitesimal. I would not myself deny that there is something in this. It is easy to find pieces of "activity analysis" that do no more than re-state a fairly obvious point in esoteric terms. Nevertheless, after all discounting, there are substantial things that remain. Most obviously, there are the contributions which have been made by the associated techniques to the solution of certain kinds of business (or other practical economic) problems; but these, though their importance is unquestionable, will not be our main concern in what follows. The contributions which have been made by the new methods to economic theory look, at first sight, much slighter.

[1] Thus Hardy, Littlewood and Polya (*Inequalities*, p. 108), writing (in 1934) of a distinct but related field: "The (calculus) method is attractive theoretically, and always opens a first line of attack on the problem; but is apt to lead to serious complications in detail (usually connected with the boundary values of the variables) and it will be found that, however suggestive, it rarely leads to the simplest solution." As we shall see, it is much the same story here.

[2] Since my own formal mathematical education (such as it was) ended in 1923, I do not pretend that I myself feel at all at home with these newer methods. I can, however, feel fairly confident about the use which I have had to make of them, because of the advice which I have received from a number of experts. My greatest debt is to Dr. H. W. Kuhn (of Princeton), who was spending the year of 1958–59 in London, and who was kind enough to criticise a first draft in considerable detail. Afterwards, in California and in Japan, I had the benefit of consultations with Michio Morishima, with Kenneth Arrow and with George Dantzig himself. To each of these (and also to the Assistant Editor of this JOURNAL, who called my attention to a qualification not easy to disentangle from the literature) I offer my thanks.

One cannot claim much more for most of them than that they are improvements in the statements we can now make of familiar points: things of which we were (more or less) aware, but which one can now realise that we were putting rather badly. I shall consider such matters in some detail. I would, however, maintain that they are chiefly worth considering because they do carry with them a deepening in our understanding of something that is rather central—nothing less than the ends-means relationship which is what so much of economics is about. Something of that will, I hope, emerge before I have finished.

## I. Origins

It is convenient to let the story begin from a simple pedagogic point.

Anyone who has attempted to put the Walrasian theory of general equilibrium (with fixed coefficients of production) on to a classroom diagram will have had something like the following experience. One cuts it down to the simplest possible case—two goods and two factors. Measuring quantities of the two goods along two axes, one gets a diagram such as that shown in Fig. 1. The quantities of the two goods that can be produced with a

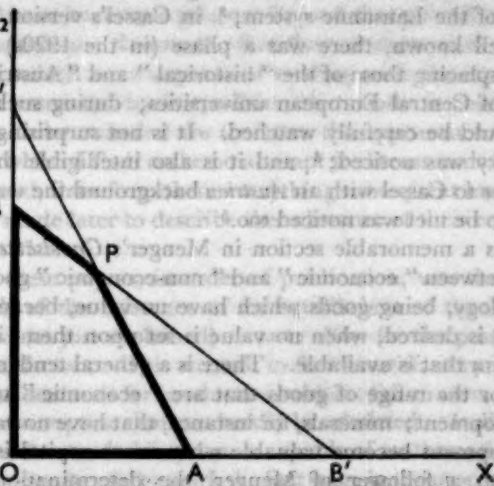


Fig. 1

given supply of factor $A$ are shown by the straight line $AA'$; the quantities that can be produced with a given supply of factor $B$ are shown by the line $BB'$; thus it is *only* the set of quantities represented by $P$, the point of intersection, that *can* be produced, so long as one assumes (as Walras assumed) that both factors are to be kept fully employed. The quantities of products, and the quantities of factors employed in the production of each, seem therefore to be determined, before anything has been said about prices, or about demands. The general equilibrium system, which is supposed to show the

way in which output adjusts itself to demand through the price-mechanism, has the serious defect, when it is regarded as a means of teaching economics: that in the simplest example, the example which it is most natural to take as an illustration, it does not work.

Now, it is, of course, true that as soon as we introduce another product (or, more generally, so long as we keep the number of products greater than the number of factors) the difficulty disappears, or at any rate becomes less acute. The quantities of products cease to be technologically determined, so that the price-mechanism can begin to function. For many Walrasians [1] that has been enough. The case of fixed coefficients, with fixed supplies of factors, has been for them no more than a stepping-stone on the way to something more general; the rigidities which appear in the elementary case have not therefore seemed to be so very interesting. Yet it must be admitted to be a defect in a theory that it does not clear up its own elementary cases. Mere consideration of the elementary case is enough to show that the Walras theory cannot be quite right.

It does not appear that much attention was paid to this weakness in the days of Walras and Pareto.[2] What brought it to the surface was Cassel's simplification of the Lausanne system; [3] in Cassel's version it rather stood out. As is well known, there was a phase (in the 1920s) when Cassel's treatise was displacing those of the "historical" and "Austrian" schools in the curricula of Central European universities; during such a struggle its weaknesses would be carefully watched. It is not surprising that this particular difficulty was noticed; [4] and it is also intelligible that by some of those who came to Cassel with an *Austrian* background the way in which the difficulty has to be met was noticed too.[5]

For there is a memorable section in Menger's *Grundsätze* [6] in which he distinguishes between "economic" and "non-economic" goods—the latter, in his terminology, being goods which have no value, because the amount of them which is desired, when no value is set upon them, is less than the quantity of them that is available. There is a general tendency (so Menger maintained) for the range of goods that are "economic" to widen in the course of development; minerals, for instance, that have no value at an early stage of development become valuable when more capital is accumulated. Accordingly, to a follower of Menger, the determination of economic equilibrium would not merely involve the determination of the prices of those goods that have prices (as in Walras); it should also involve the

[1] Including the present author, when he wrote *Value and Capital* (1939).

[2] It should be noticed that Walras' basic fixed-coefficient model did not assume fixed factor-supplies.

[3] *Theory of Social Economy*, Part II.

[4] See the discussion of W. L. Valk's *Principles of Wages* (1928) in D. H. Robertson "Wage Grumbles" (*Economic Fragments*, p. 52).

[5] Articles by Neisser (*Weltwirtschaftsliches Archiv*, 1932), Stackelberg (*Zeitschrift für Nationalökonomie*, 1933) and Zeuthen (also in *Zeitschrift für Nationalökonomie*, 1933) are widely quoted.

[6] Chapter 2.

determination of which goods are to have prices, and which are to be free. The weakness of the Walras–Cassel construction lies in the implied assumption that the whole amount of each available factor is utilised; once that assumption is dropped, the awkwardness of the construction (even in the two-good, two-factor case) can be shown to disappear.

It is at once apparent, if we drop the assumption that both factors must be fully utilised, that the possible combinations of products that can be produced from available resources are not confined (in Fig. 1) to the point $P$; they comprise all those combinations that are represented by the whole area $OAPB$. Nor is $P$ the only *efficient* combination; for if product $X_2$ were not *wanted*, $OA$ would be the maximum amount of $X_1$ that could be produced; there would be a sense in which production would be maximised all along the broken line $APB$. The only peculiarity of the point $P$ is that it is the only point at which both factors are scarce. If we do not assume that, the whole of $APB$ becomes a *frontier*. As demand varies, the equilibrium point can move from one end of this frontier to the other. Throughout the whole of this process the price-mechanism is working.

It is easy for the "intuition" of the "literary" economist to get that far; but there would have been little progress beyond that point if it had not been for the mathematicians. It was the fact that mathematical methods were being prepared, which were capable of dealing with the equilibrium of a system which is restricted by inequalities, that made it possible to go on. The next events to be recorded are therefore the appearance of two mathematical papers, which I shall make no attempt to discuss in detail, but which must be mentioned, since from them everything subsequent has sprung. An attempt will be made later to describe the substance of their contributions in different terms.

The first of these papers, in order of publication, was the "proof," by Abraham Wald, of the existence of an equilibrium of the Walras–Cassel system, extended (as just explained) so as to allow for the possibility of free, as well as scarce, factors. This was not in fact a satisfactory proof, since it assumed that the demands for products would not fall to zero, however high prices rose—an assumption that can hardly be admitted. It did nevertheless establish that the "extended" system is capable of mathematical manipulation; it may therefore be said to mark the first stage in the process by which the "Austrians" had their mathematical revenge on the followers of Walras.[1]

[1] Wald's paper was presented (with an introduction by Karl Schlesinger) to a seminar in Vienna presided over by Karl Menger (mathematician son of the economist Menger) in March 1934. It was printed in *Ergebnisse eines mathematischen Kolloquiums*, Heft 6, 1935. There is a further paper in the following issue of the same publication, and an article (which, among other things, summarises the results of these mathematical papers) in *Zeitschrift für Nationalökonomie*, 1936. The *Zeitschrift* article was translated into English (*Econometrica*, 1951).

The reasons which led Wald to make his curious assumption about demand functions have been explored by Dr. Kuhn ("On a Theorem of Wald" in *Linear Inequalities and Related Systems*, Annals of Mathematics Studies 38, Princeton, 1956). I shall be returning to this matter later. (See below, p. 699.)

Much more important, for what followed, was the other: the famous paper by John von Neumann "A Model of General Economic Equilibrium" (to give it the title by which it is known to English readers).[1] It has been the extraordinary achievement of this work that it has had a profound influence on the development of economic thinking in several different directions. As a dynamic model of an expanding economy, it has been the father of many growth models; but it also has some more static aspects (which alone concern us in this place[2]); as things have turned out so far, the influence of these has been at least as important. The dynamic model is built up as a sequence of "single-period" links; each of these links, since there is no opportunity for adjustments over time *within* it, can be regarded as a static (or timeless) system. The form in which von Neumann studies this static system is substantially that which we have been calling the "extended Walras–Cassel"; but in his hands this is already passing over into *activity analysis*. He does not content himself with allowing for the possibilities that available inputs may not be used, feasible outputs may not be produced; he allows for the possibility of joint products, and that available processes may not be employed. Besides, there is included in von Neumann's construction a first statement of what was to become known as the Duality principle (of which I shall have much more to say later). It is singularly appropriate that it was von Neumann who introduced that principle into the theory of economic optimisation, for it is the link which establishes a connection (we shall be examining later what sort of a connection) between that theory and the Theory of Games.

From this point, the later developments begin to branch out; but before discussing these later developments, it will be well to attempt a statement of the stage so far reached. There is indeed no single work which can be said to correspond at all exactly to the stage I have in mind. New ideas tumble out one after another with such rapidity in von Neumann's few pages, that he is already in the middle of the next chapter before he has finished with the first. It will be useful here to take things more slowly. The "prototype" theory which I shall describe in the next section will still run in terms of "extended Walras–Cassel"; that is to say, it is solely concerned with the allocation of given factor supplies in the production of a number of products, each of which is to be made by combining factors in proportions that are technically given. Only afterwards shall I go on to the reinterpretations, by von Neumann and others, which have not merely allowed for variable

[1] There is an awkward question of priority. The von Neumann paper was also published in the Menger *Ergebnisse* (Heft 8, for 1935–36, published 1937). (The English translation is in *Review of Economic Studies*, No. 33, 1945–46.) It is, however, understood that it was originally presented to a seminar at Princeton in 1932, which puts it before Wald, and even before such things as the Neisser article above mentioned. (I know, from personal recollection, that he had these things in mind in September 1933, when I met him with Kaldor in Budapest. Of course I did not understand what he was saying!)

[2] Although all the theories we shall be discussing have (or can have) dynamic aspects, the static side will give us quite enough to deal with.

proportions of factors, for joint supply and for intermediate products (all of which things are left out in the prototype), but have enabled the analysis to be applied to problems of business management which are at first sight of quite different kinds. One of the main difficulties with later writings is that they are (rightly) so impressed by these reinterpretations that they insist on beginning their exposition on a high plane of generality. I find it easier to take one thing at a time; though the theory which will now be described is mainly interesting because it can be generalised, it is easiest to put it, at the first round, in a rather conventional setting.

## II. The Prototype

1. Given amounts of $M$ factors of production are available; we will call these amounts $b_1, b_2, \ldots b_M$. There are $N$ products which can be produced by the utilisation of these factors; the (as yet undetermined) amounts of these products we call $x_1, x_2, \ldots x_N$. There are fixed technical coefficients; that is to say, the amount of each factor required to make a unit of each product is given. The amount of the $i$th factor needed to make a unit of the $j$th product we call $a_{ij}$.

It is clearly implied, when the problem is stated in these terms, that the constants ($a$'s and $b$'s) must obey certain restrictions if they are to make economic sense. Though these restrictions look terribly obvious, we shall get into serious trouble if we do not put them down. (1) Every $b_i$ must be positive; negative factor supplies are meaningless, and a product that required a factor that was in zero supply could not possibly be produced. (2) The technical coefficients $a_{ij}$ cannot be negative; we may, however, allow some of them to be zero—not every factor need be required for every product. (3) But some amount of at least one factor must be required for every product; there can be no $j$ for which $a_{ij} = 0$, for all $i$. Mathematically, these restrictions define what we are calling the prototype problem. Since they were (I believe) first set out formally by Wald, I shall call them (together with a fourth rule to be mentioned later) the *Wald rules*.

If a set of outputs $(x_1, x_2, \ldots x_N)$—or, more briefly $(x_j)$—is to be *feasible* it must satisfy two sets of conditions, or *restraints*. First, no $x_j$ may be negative (though some or all may be zero); this again looks obvious, but again it is vital that such obvious matters are not overlooked. Secondly, the amount of any factor that is required to produce the set $(x_j)$ must in no case exceed the amount of that factor that is available. The first set of restraints —that $x_j \geqslant 0$ for all $j$—might be called product restraints, but (with an eye on subsequent generalisation) I prefer a more general description. I shall therefore call them *sign restraints*. The second set, which imply that

$$\begin{aligned}
a_{11}x_1 + a_{12}x_2 + \ldots + a_{1N}x_N &\leqslant b_1 \\
a_{21}x_1 + a_{22}x_2 + \ldots + a_{2N}x_N &\leqslant b_2 \\
\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot & \\
a_{M1}x_1 + a_{M2}x_2 + \ldots + a_{MN}x_M &\leqslant b_M
\end{aligned}$$

I shall for the same reason call *specific restraints*. There are $N$ sign restraints and $M$ specific restraints, $M + N$ in all. There are $N$ $x$'s to be determined. Thus the number of restraints is always *greater* than the number of unknowns, when all restraints are taken into consideration.

As always in such cases, it is a great help to make as much use as we can of a diagrammatic representation. The problem which has just been set out, for $M$ factors and $N$ products, is precisely that which was expressed, for two factors and two products, in Fig. 1. The feasible *region*,[1] as drawn, was bounded by straight lines that corresponded to the four restraints: two sign restraints ($OA$ and $OB$), two specific restraints ($AA'$ and $BB'$). The Wald rules have made it necessary that we should get a feasible region that is something like $OAPB$. It is clearly not excluded that one of the specific restraints might have been ineffective (if $AA'$, $BB'$ had failed to meet within the positive quadrant) so that the feasible region might have been reduced to a triangle. And it is clearly not excluded that one (or both) of the specific "arms" might have been parallel to an axis; what is excluded is that they should both be parallel to the same axis, for that would mean that there was a product which did not require any factor, and that is ruled out. It would therefore seem that the polygonal form (such as $OAPB$), or something like it, is going to be typical.

2. It would now be possible to pose the problem before us in the form of asking for a determination of all feasible solutions: the answer to that question, in the case illustrated, would be the definition of the whole area $OAPB$. But out of all these points, it is only those that lie upon the frontier $APB$ which are really interesting; it is only these which, in some sense or other, "maximise output." How do we distinguish between these frontier points and the rest of those that are feasible? There are, in principle, two ways of making the distinction.

One is to say that a feasible point is a frontier point if it is a terminus of a vector from the origin; that is to say, if it is laid down that the various outputs are to be produced in fixed proportions, the quantity of any product (and hence of the composite product) that is produced must be maximised. The other is to say that if the products are valued at fixed prices ($p_1, p_2, \ldots p_N$) the value of output ($\sum p_j x_j$) must be maximised. (It must be clearly understood, if we adopt this second distinction, that the $p$'s must be non-negative; we may allow some of them to be zero, but it will be nonsense for all to be zero. This is the fourth of the Wald rules.)

There are economic purposes for which the difference between these two approaches is very important; the whole theory of increasing returns may be said to depend upon it. It can, however, be shown [2] that under present

[1] I am aware that for mathematicians the term *region* has connotations of continuity which are not necessarily implied in the uses I shall be making of it. A more correct terminology would, however, involve explanations which for present purposes are largely irrelevant. In this, and some other cases, I must ask forgiveness for a use of terms in something looser than the strict mathematical sense.

[2] See below, p. 689.

assumptions they come to the same thing, so it does not matter which we use. It has proved to be more convenient to work with the test by value of output, according to which a position on the frontier is found by maximising $\sum px$ for given $(p)$. A set of outputs which does this, subject to the restraints, is called an *optimum*.

It is at once apparent that for the case which is shown in our diagram there are two sorts of optima. (1) The optimum may be *at a vertex*, such as $A$, $P$ or $B$. (2) The optimum may be, as we shall say, *on a flat*—on $AP$ or $PB$. There will be several values of the price-ratio $(p_1/p_2)$ which will correspond to each vertex optimum; but it is only particular values of the price-ratio which will give a flat optimum—but for those values any point on the flat can be optimum. It will now be shown that the distinction between vertex optima and flat optima is quite generally valid; but for that purpose we need some more general definitions.

3. Let us begin by looking at the vertices on our diagram more closely. At $P$ the two products are both being produced, and the two factors are both scarce; thus we have two positive products (as we may call them) and two scarce factors. At $A$ (and at $B$) there is only one positive product, and one scarce factor. At $O$ (which must be reckoned as a vertex, though—so long as the Wald rules hold—it cannot be an optimum) we have no positive product and no scarce factor. Thus at all the vertices the number of positive products is equal to the number of scarce factors.

When a factor is scarce the corresponding specific restraint becomes an equation; we may then say that the restraint is *operative*. Thus the vertex $P$ is determined by two specific restraints which are operative. At $A$ there is only one specific restraint which is operative; but the place of the other is taken by a sign restraint, which now becomes operative $(x_2 = 0)$. At $O$ it is only the sign restraints which are operative. Thus each of the vertices is determined by two operative restraints—two equations to determine the two unknowns. A general rule for the determination of a vertex is accordingly suggested: a vertex is a set of $N$ outputs $(x_j)$ which is determined by $N$ operative restraints, to be selected from the total number of restraints $(M + N)$. But this is not quite the whole story.

For (as is again apparent from the diagram) the list of points which would be calculated by this rule is longer than the list of vertices. When the above procedure is applied to that elementary case it would not only throw up the true vertices ($A$, $P$, $B$ and $O$); it will also throw up the pseudo-vertices ($A'$ and $B'$). These must clearly be excluded; what excludes them? They are excluded by their failure to satisfy some of the restraints which in their determination have been taken as non-operative. A true vertex is a set of outputs which is determined by selecting $N$ of the $M + N$ restraints to be operative, and which also satisfies (as inequalities) the remaining non-operative restraints. Thus, when the optimum is at a vertex, the number of

positive outputs should be equal to the number of scarce factors; and the non-scarce factors should be in excess supply.

4. So much for the vertices; now for the optima which lie *on the flat* between the vertices. It is clear that the number of scarce factors cannot ordinarily [1] be greater than the number of positive products; for if it was, we should have more equations than unknowns, and the system would be over-determined. But it is perfectly possible that the number of scarce factors may be *less* than the number of positive products. (Thus for an optimum between $A$ and $P$, on Fig. 1, we have two positive products, and only one scarce factor.) It will later be shown that this is a general characteristic of flat optima; but it will be more convenient, for the moment, to define them, and to get out their properties, in another way.

It is a well-known rule that if $\alpha$, $\beta$ are two points on a line, with co-ordinates $(x_\alpha, y_\alpha)$ $(x_\beta, y_\beta)$, the co-ordinates of any other point on the line can be expressed as $(k_\alpha x_\alpha + k_\beta x_\beta,\ k_\alpha y_\alpha + k_\beta y_\beta)$ where $k_\alpha + k_\beta = 1$. In terms of these *weights*, the point $\alpha$ is $(1, 0)$; the point $\beta$ is $(0, 1)$; any point on the line *between* $\alpha$ and $\beta$ will have both weights positive; any point outside $\alpha\beta$ will have one weight negative. There is therefore a sense in which we can regard any point on the line between $\alpha$ and $\beta$ (including $\alpha$ and $\beta$) as being a *weighted average* of $\alpha$ and $\beta$; it being understood that the weights are non-negative, and add up to 1.

The points on the flat between $A$ and $P$ (on Fig. 1) can thus be regarded as weighted averages of $A$ and $P$—two vertices which, in the case where the optimum is on the flat, must be such that at them the value of output $V\ (=\sum px)$ is the same. It is accordingly suggested that we might define the flat optimum as a condition in which two (or more) vertices give the same value of output; any weighted average of these vertices may then be an optimum. It is evident that if $V$ takes the same value at each of the points $(\alpha, \beta, \ldots \lambda)$, it will also take the same value at any weighted average of $(\alpha, \beta, \ldots \lambda)$. But before we can accept this definition there is a further matter to be cleared up.

If a point is to be an optimum it must be feasible; how do we know that these points, defined as weighted averages of vertices, are feasible? It can in fact be shown that they must be; this is a special case of a general, and very important property—*any weighted average of a set of feasible points must be feasible*. The mathematical name for this property is *convexity*; [2] what we have to show is that the feasible region is convex. The proof is as follows.

Let $(\alpha, \beta, \ldots \lambda)$ be feasible points. Take the point which is expressible as the weighted average $(k_\alpha, k_\beta, \ldots k_\lambda)$. Substitute its co-ordinates (written in full) into any one of the specific restraints, say the $i$th. Then

$$a_{i1}x_1 + a_{i2}x_2 + \ldots a_{iN}x_N = k_\alpha(a_{i1}x_{1\alpha} + a_{i2}x_{2\alpha} + \ldots + a_{iN}x_{N\alpha}) + \ldots + k_\lambda(a_{i1}x_{1\lambda} + a_{i2}x_{2\lambda} + \ldots a_{iN}x_{N\lambda}) \leqslant k_\alpha b_i + k_\beta b_i + \ldots + k_\lambda b_i$$

[1] It will later appear that there is a qualification to this statement which is of some importance.

[2] For a further discussion of this concept, see below, p. 687.

since $(\alpha, \beta, \ldots)$ satisfy the restraints, and the $k$'s are non-negative. Then, since the $k$'s add up to 1, the last sum is $b_i$. Thus any weighted average satisfies the specific restraints, and can be shown to satisfy the sign restraints in the same way. Thus it is feasible.

It is accordingly safe to lay down that when there is a "tie" between vertex optima any weighted average of these vertex optima is itself an optimum. That is what the *flat optimum* means.

5. So far we have (basically) been arguing from analogy; the method described in the last paragraph can, however, be used to give something which is a bit nearer to a proof of the properties in question.

It is not only the points *on the flat* which can be regarded as weighted averages of vertices; if we bring all the vertices into account, any point within the feasible region (inside the region, or on its boundary) can similarly be expressed as a weighted average of vertices. (This can often be done in several ways, but that does not matter.) Further, in view of the convexity of the region, it is *only* points that are within the region that can be thus expressed. Suppose that we now take $(\alpha, \beta, \ldots \lambda)$ to be the vertices, and consider a point which can be expressed by $(k_\alpha, k_\beta, \ldots k_\lambda)$. Substituting its co-ordinates into the value of output, as we have previously substituted into the restraints, we get

$$V = \sum px = k_\alpha V_\alpha + k_\beta V_\beta + \ldots + k_\lambda V_\lambda$$

where $V_\alpha, V_\beta, \ldots V_\lambda$ are the values of output at the vertices. Then, since the weights are non-negative and add up to 1, it is obvious that in the case where there is one of the $V$'s which is larger than any of the others, the optimum is reached if the whole weight is placed at that vertex; while in the case where there is a "tie," an optimum will be reached by dividing the weight between the tying vertices *in any manner*. That is all that there is to be said.

6. So far as the determination of the optimum is concerned, that completes the prototype theory; the most remarkable development of the theory is nevertheless still to come. This is concerned with the determination of factor prices.

Let us go back, for a moment, to the "Walras" model, of the two factors and two products, with which we began. It is not merely the case that if we analyse it in Walras' manner, outputs appear to be established independently of demands; it is also the case that (if product prices are assumed to be given),[1] factor prices appear to be determined independently of the supplies of the factors. Corresponding to the *equations*

$$a_{11}x_1 + a_{12}x_2 = b_1, \quad a_{21}x_1 + a_{22}x_2 = b_2$$

(which make outputs seem to depend upon technical coefficients and factor

[1] Walras, of course, did not assume that they were given. That this is an important assumption has nevertheless been brought to the attention of economists by Samuelson (see his Factor Price Equalisation Theorem).

supplies only), there are the equations of prices and costs (that there is no profit that cannot be imputed to some factor); these will read

$$w_1a_{11} + w_2a_{21} = p_1, \quad w_1a_{12} + w_2a_{22} = p_2$$

Taken by themselves, they seem to make the factor prices $w_1, w_2$ depend upon product prices and technical coefficients only.

As we have seen, the first set of equations is not universally valid. It needs to be completed so as to allow for the possibility of a factor being in excess supply; when that is done, demands come back into the picture. An exactly analogous argument, applied to the second set, uncovers the assumption that the outputs of both products are positive. If that is not so, if (say) $x_2 = 0$, there is no reason why the cost of the second product should equal its price. A possible combination of factor prices would be such that price equalled cost for the first product, but fell short of cost for the second. The second would not then be produced; it would not pay to produce it.

This simple example is sufficient to show that the theory of imputation (derivation of factor prices from product prices) needs to be completed by an inclusion of "inequality" cases, just as has been done for the theory of quantity optimisation. It also suggests (what proves to be true) that there is a sense in which the one theory is a mirror image of the other. Let us look at this more generally.

7. Suppose that at a particular optimum, $n$ of the $N$ possible products are positive products, the remaining $N - n$ having zero outputs. And suppose that $m$ of the $M$ factors are scarce factors, the remaining $M - m$ having zero factor prices.[1] Then it would appear from our preceding discussion (though there is qualification to this to be made in a moment) that at a vertex optimum $m = n$, while at a flat optimum $m < n$. We must again look at these two cases separately.

At the vertex optimum we have $m = n$ equations of the form $\sum a_{ij}x_j = b_i$ to determine the $n$ positive outputs; and (since price equals cost for each of these $n$ products) we have an equal number of equations, of the form $\sum w_i a_{ij} = p_j$, to determine the $m = n$ prices of the scarce factors. Corresponding to the other factors, where $w_i = 0$, we have the inequalities $\sum a_{ij}x_j < b_i$. Corresponding to the other products, where $x_j = 0$, we have the inequalities $\sum w_i a_{ij} > p_j$. Apart from the difference in sign of the two sets of inequalities, there is complete symmetry.

The flat optimum is at first sight more perplexing. Here we have $m < n$; there are only $m$ equations to determine the $n$ positive outputs; these outputs are therefore under-determined, but that (it will be remembered) is what they should be. On the other hand, we have $n$ equations $\sum w_i a_{ij} = p_j$ to determine the $m$ prices of the scarce factors; these seem therefore to be over-determined. The explanation is that it is not possible for a flat optimum to occur at any arbitrary set of prices ($p$); it can only

[1] I take it for granted that the factor prices of the non-scarce factors are zero.

occur at particular sets of $(p)$, which are related in such a manner that the $n$ equations of prices and costs can be simultaneously satisfied. (The *labour theory of value*, regarded as a statement that the prices of positive products must be proportional to their labour costs, when labour is the only scarce factor, may be regarded as a particular case of this proposition.) If we have begun with an appropriate $(p)$, we can get a flat optimum, with a corresponding $(w)$. The restraints on the $(x)$ will be operative, for all factors where $w_i$ is not zero; and the restraints on the $(w)$, as we may begin to call them, will be operative, for all products where $x_j$ is not zero. Where $w_i$ is zero, and where $x_j$ is zero, we have the same inequalities as before.

But now, having found a way of overcoming the obstacle of over-determinateness in the case where $m < n$, we should look back to see whether we have not been too precipitate in the other case. Would it not have been possible to have found a way round, in a similar manner, which would have salvaged the possibility that $m > n$? The factor prices would then have been under-determined, so that there would have been "flatness" on that side—there is no difficulty about that; but the only way in which $m$ operative equations on $n$ positive products can all be satisfied, when $m > n$, is for there to be some special relations between the factor supplies $(b)$, just as there had to be suitable relations between the $(p)$ in the opposite case. There is no doubt that this way out is mathematically valid, and it is useful as showing how we may complete the symmetry; but I have refrained from bringing it in until now, since I think that the economist is justified in feeling a little shy of it, at least in the present application. He is undoubtedly interested in the optima that will be reached at various $(p)$, some of which will certainly be inter-related, so that the case where $m < n$ is important to him; but he had begun by thinking of the factor supplies as *given*, so that inter-relations between them, which would enable more than $n$ factors to be scarce simultaneously, would be rather a fluke. Still, it is a possibility, and it is a possibility which, at this stage, has important consequences.

For what we now come to is the Principle of Duality. The conditions which govern the outputs $(x)$ and the factor prices $(w)$, in an optimum position, correspond exactly. We had, however, determined the $(x)$ in a way which could be completely described without introducing the $(w)$; since the restraints on the $(w)$ are so remarkably similar, it is strongly suggested that the $(w)$ might themselves have been *independently* determined in a similar way. That this is in fact so can be shown as follows.

8. We started with the condition that the $(x)$ should be *feasible*: in the sense that they are non-negative, and that their factor requirements do not exceed the available factor supplies—that is to say, that $\sum a_{ij}x_j \leqslant b_i$ for all $i$ from 1 to $M$ (the specific restraints). We found ourselves imposing a parallel set of restraints on the $(w)$: that they should be non-negative, and that the costs of the products, at these factor prices, should equal or exceed the given product prices—that is to say, the $\sum w_i a_{ij} \geqslant p_j$, for all $j$ from 1 to $N$ (which

we may now regard as specific restraints on the $(w)$). Evidently we may say that the $(w)$ are *feasible* if they satisfy the restraints just laid down.

Now take the specific restraints on the $(x)$, multiply each of them by the corresponding $w$, and add. Since if the $(w)$ are feasible, they must be non-negative, the resulting inequality will hold, whenever both $(x)$ and $(w)$ are feasible. What it states is that the cost of the set of outputs $(x_j)$, valued at the factor prices $(w_i)$, cannot exceed the aggregate value of the factors at those same factor prices. If this cost is $C$, and this factor value $B$, we have $C \leqslant B$, whenever $(x)$ and $(w)$ are both feasible.

Then take the specific restraints on the $(w)$, multiply each by the corresponding $(x)$, and add. If both $(x)$ and $(w)$ are feasible, the inequality which results from this operation must also hold. What it states is that the aggregate value of the products, at prices $(p)$, cannot exceed the aggregate cost of those products, at factor prices $(w)$. $V \leqslant C$, when $(x)$ and $(w)$ are both feasible.

So far we have made no use of the optimum conditions. But it is easy to show that when $(x)$ is optimum, $C = B$; for when $w_i$ is positive the corresponding restraint is then an equation, and when it is not an equation, the corresponding $w_i = 0$. Similarly, when $(w)$ is optimum—or such as to correspond to an optimum $(x)$—we have $V = C$. Thus, when $(x)$ and $(w)$ are both optimum, we have $V = C = B$. (The social accounts come out right!)

For any feasible $(x)$ and $(w)$, $V \leqslant B$; no feasible $V$ can exceed any feasible $B$. The feasible $B$'s lie above the feasible $V$'s, except for the possibility that some feasible $V$'s and some feasible $B$'s may be equal. At the optimum, $V = B$, so that at the optimum this equality is realised. It follows that no feasible $V$ can exceed the optimum $V$, so that at the optimum $V$ is maximised; that, of course, does no more than confirm the definition with which we started. But it also follows that no feasible $B$ can be less than the optimum $B$, so that at the optimum $B$ is minimised. We could have determined the "equilibrium" factor prices as an *independent* optimum problem: by seeking those factor prices which minimise factor value, subject to the condition that the unit cost of no product shall fall below its given (product) price.

9. That, I think, is the easiest way of demonstrating, or at least of explaining, the Duality Principle; but there is perhaps a little more to be said in order that the significance of the principle should be fully brought out. It is rather a defect of the foregoing treatment that it has had to introduce the factor prices, in Walras' manner, as elements in a model of competitive capitalism, in which the factor prices govern *distribution*; in the other part of the theory, in which the optimum *quantities* had been determined, no such assumption as this had been required. It would in fact have been possible to have introduced the factor prices, without reference to distributive shares, as instruments of quantity optimisation; though it would not have been so

easy to carry through the argument in detail, we might have proceeded on something like the following lines.

Suppose that arbitrary (non-negative) prices are set upon the factors, and that an entrepreneur (or planner) is provided with a fund which is just sufficient to enable him to employ the whole of the available supplies of the factors at those given factor prices. Suppose that he seeks to maximise the value of output, under the single (specific) restraint that the cost of output is not to exceed the value of his fund; that is to say, that $C \leqslant B$. The outputs which he will select will, very likely, not be feasible; they will infringe some or other of the *separate* specific restraints, which (we are of course supposing) do still in fact hold. It does, however, follow from our previous analysis (it would be nice if there were some simple *direct* proof, but I do not see one) that there will be some set of factor prices, our optimum ($w$), at which the optimum that he selects will in fact be feasible, and will indeed be an optimum of the whole system. The optimum factor prices are the *right* factor prices in this sense.

On this approach, distribution only comes in, if at all, in a secondary manner. If all the factor prices are changed in the same proportion the restraint $C \leqslant B$ is unaffected *in real terms*; just the same combinations of outputs are open, or appear to be open, as before. Thus, by the preceding test, the optimum ($w$) remains indeterminate, to the extent of a multiplier; in order to determine its level, we have to impose some additional condition, and the condition that the value of output, at the optimum, should be equal to its cost is one that will obviously be convenient to impose. Then it all falls out as explained.

This is more the way in which economists have thought of the determination of factor prices belonging in with that of product quantities; the discovery that factor-price determination is an optimum problem in its own right, so that we can begin at either end, is distinctly harder to place. One can see that it makes sense in economic terms (when the possibility of zero outputs is allowed for); but it is hardly a formulation which would have occurred to the economist if it had not been suggested to him by the mathematician. The nearest thing which might have occurred to him would have been to say that the maximisation of output is a minimisation of the scarcity of the resources applied. That is a way in which an economist might want to talk, but he would hardly have believed that he was quite correct in doing so. What he is now to learn is that there is a way in which he is justified in doing so, after all.

## III. Beyond the Prototype

The summary which has just been given has been confined to a statement of the Linear Theory in Walras–Cassel terms; it should, however, be emphasised that none of the standard works do put it in those terms, and the

reason why is fairly evident. The reactions which we have appeared to be analysing so minutely—the changes in the sorts of factors that are scarce, and of producible products that are actually produced—are hardly so important in the real world, as to be deserving of such elaborate attention. Certainly it seems odd to deal with them in such detail before we deal with more important matters. The Walrasian habit of taking these things as settled, *before* the equilibrium system is set up, is not (in direct application) so very unreasonable. The chief reason why the prototype theory is very well worth having is that, once we have it, it can so easily be interpreted in other ways.

On the way to these economic reinterpretations there are, however, some mathematical reinterpretations and extensions which need to be noticed. To the mathematician these are rather obvious; they are the reason why no mathematician would ever stop at the prototype theory. But since they have been excluded from the prototype theory, they must be set down before going further.

1. It will be remembered that in our formulation of the prototype we began by imposing certain " economic " restrictions on the constants—the Wald rules. The $a$'s were to be non-negative (with the qualification that some factor must be required for every product); the $b$'s were to be positive; and then there was the supplementary rule that the $p$'s were to be non-negative (but not all zero). Useful as these restrictions were to begin with, it may have been noticed that by the end of our discussion they were wearing rather thin. The minimisation problem, which emerged as the dual, could itself have been stated as a maximisation problem, in the same form as the original (or " primal," as it is coming to be called); but in that case the signs of *all* the constants would have had to be reversed. We took it for granted that a problem of that kind could be dealt with in much the same way. But this raises the broader question: do we need to put any restrictions on the constants?

Mathematically, the answer is no. Almost the whole of the foregoing can be re-worked without the Wald rules; so that any $a$, $b$ or $p$ can be allowed to be positive, zero or negative. The chief trouble which arises if this is done (it is the reason why it seemed best to begin with the Wald rules) is that we have to allow for some side possibilities, which are obviously excluded in many economic interpretations, so that it was rather a convenience to be able to ignore them at a first round. I shall not attempt, even here, to work them in properly; some brief description must, however, be given.

It is possible, in the first place, if no restrictions are set upon the constants, that there may be no feasible solution, no " feasible region." The specific restraints may be mutually contradictory, or they may contradict the sign restraints. (For example, $x_1 \leqslant -6$ is a possible specific restraint if we allow any constants; but it contradicts the sign restraint $x_1 \geqslant 0$.)

Secondly, even if there is a feasible region, it is not necessary that it should

be optimisable for a given ($p$). Clearly, if there were no specific restraints (only sign restraints), while the $p$'s were positive, there would be no optimum, since $V$ could be indefinitely increased. The same thing may happen if there are specific restraints, when they fail to confine the feasible region in some direction.

Neither of these things can happen under the Wald rules; they cannot happen with the primal,[1] nor (it is important to notice) can they happen with the prototype dual.[2] This is a particular case of a general theorem, the general *Duality Theorem*, which states that if an optimum exists for the primal, it exists also for the dual. I shall make no attempt to prove this theorem, which is true for any values of the constants. There is also an extension of the theorem, which connects the two exceptions: it states that if the primal, though feasible, is unoptimisable, the dual will not be feasible.[3] Since (of course) either problem may be regarded as primal, the correspondence holds (in a sense) both ways. It is, however, worth noticing that the possibility remains open that both primal and dual may not be feasible.[4] This is a rare case, but it can arise.

2. *Convexity.* If a feasible region exists it must be convex; for the proof of convexity (which was given above [5]) is independent of the Wald rules; it will hold for any values of the constants.[6] We are still dealing with convexity properties, and shall continue to do so in all the forms of the linear theory. Since this has the effect of setting a sharp limitation on the range of economic problems to which the theory is applicable, it will be well to consider the concept a little more deeply before going further.

What is the relation (we may begin by asking) between this convexity concept and that which has hitherto been more familiar to economists, in the works, for instance, of Pareto or Joan Robinson? We are accustomed to say that a curve such as $AB$ (Fig. 2) is "convex outwards" if its steepness continually increases as one moves downwards along it. This definition is clearly different from that to which we have here come, since the one is a property of a region, the other of a curve; but since the region $OAB$ is

[1] Under the Wald rules the origin (all outputs zero) is always feasible. That is enough to show that a feasible region must exist. Increasing ($x$) along any vector will always encounter a restraint; $V$ must therefore have a maximum value.

[2] Under the Wald rules a zero value for all $w$ is *never* feasible; but a feasible solution can always be found by giving the $w$'s sufficiently large *positive* values. Between the corresponding value of $B$ and the zero value (which is not feasible) a minimum value must exist.

[3] This can easily be illustrated by a slight variation of our Prototype case.

If we maintain the other rules, but allow the existence of one product which does not require any factor to make it, the primal will be unoptimisable, if that product has a positive price. But the cost of that product must be zero, at any factor prices; so it must fall short of the positive product price; the dual cannot be feasible.

[4] An example is given in Vajda, p. 78.

[5] See above, p. 680.

[6] Other parts of the "prototype" argument would require more modification; but I shall not go into that here.

convex on the new definition,[1] while $O'A'B'$ is not, it does look as if there would be some sense in saying that a convex region is one that is bounded by something like a " convex outward " curve.

It is indeed true that a convex region can be defined in something like this manner. The convexity of the curve $AB$ (Fig. 2) could have been indicated by the fact that the tangent, at any point of the curve, lies outside the region $OAB$ except at the point of contact. We can get rid of the exception about the point of contact (rather awkward in the case of linear boundaries) if we put the same property a little differently. We can define a convex region as one which is such that through any point *outside* the region

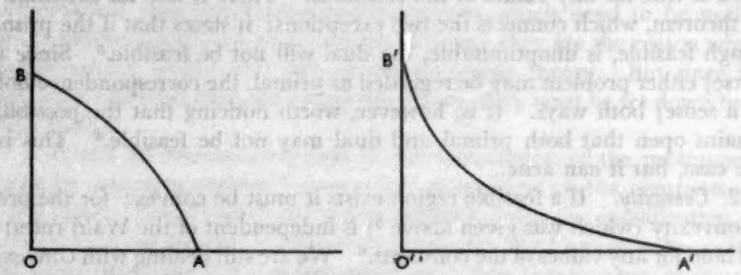


FIG. 2

a line [2] can be drawn so that the whole of the region lies on one side of the line (with no point of the region lying on the line). It is obvious that if a region is " dented " (like $O'A'B'$), this condition will not be satisfied at a point which lies within the " dent." It can be proved that this " no dent " definition amounts to the same thing as the " weighed average " definition which we used previously.

I shall not attempt to prove this equivalence; it is one of the things which economists may reasonably take over from the mathematicians.[3] It is nevertheless of much use to the economist to know that the equivalence exists. For once we have it, we can at once see that the convexity, which is so important in the linear theory, is fundamentally the same thing as that which we are accustomed, in our diagrams, to think of as a phenomenon of *diminishing returns*. Convexity, in the new sense, covers constant returns as well as diminishing returns (if $AB$ were a straight line, the region $OAB$ would still be convex). What it does not cover is increasing returns (as illustrated

[1] It is sufficient to observe that if $\alpha$ and $\beta$ are two points within the region (or on its boundary) any point between them on the line joining them will be within the region in the same sense.

[2] In two dimensions; plane, or whatever corresponds, in more than two.

[3] To prove that " convexity no-dent " implies " convexity weighted-average " is not difficult; to prove it the other way (the " theorem of the supporting hyper-plane ") is distinctly more awkward. There is a proof in von Neumann and Morgenstern, *Theory of Games*, pp. 134 ff; see also Vajda, *op. cit.*, p. 22. The neatest proof which I know is that given by Debreu in an appendix to Koopmans and Bausch, *Selected Topics in Economics involving mathematical reasoning*, Cowles Foundation Paper No. 136, p. 96.

by $O'A'B'$). We can check this by observing that, under increasing returns, an output of zero at a cost of zero may be feasible, an output of $x$ at a cost of $c$ may be feasible, but an output of $\frac{1}{2}x$ at a cost of $\frac{1}{2}c$ will *not* then be feasible.

Under increasing returns, also, there will be a lack of correspondence between the two senses of optimum. A position which maximises output in the quantity sense (that it is the maximum that can be produced when the output of commodities are to be combined in fixed proportions) will not necessarily be one which maximises the value of output at *any* set of product prices. It is a convexity property (a consequence of the equivalence of the two definitions of convexity) that the two senses of optimum come together.

We are accordingly in sight of a rather powerful re-statement of a distinction which has long been known to be crucial for economics. The reason why constant-returns assumptions, and diminishing-returns assumptions, are so much more manageable than increasing-returns assumptions, is that in the former cases we can use convexity properties, while in the latter we cannot. There is in fact not much difficulty in dealing with phenomena of diminishing returns by linear methods (a curve can always be approximated by a polygon);[1] but the linear theory, since it is based upon convexity, cannot be extended, without losing most of its virtues, into the realm of increasing returns.

3. *The Equational Form.* This is a convenient point at which to mention another complication—that the form in which we have been posing the optimisation problem is by no means the only form in which what is in substance just the same problem can be put.

The excess supplies of the factors (which are zero in the case of scarce factors, and have to be positive when the factor is not scarce) are themselves a part of the (primal) problem; they are determined, along with the outputs ($x_j$), when we maximise $V$ subject to the restraints. If they had been introduced explicitly, the primal problem could have been expressed as a maximisation of $V$, subject to the *equations*

$$a_{i1}x_1 + a_{i2}x_2 + \ldots + a_{iN}x_N + e_i = b_i$$

(for all factors), together with the sign restraints on the outputs and on the excess supplies ($x_j \geqslant 0$, $e_i \geqslant 0$). Now, as soon as we have left the Wald rules behind us (so that we do not have to worry about the signs of the constants), this is exactly the same thing as maximising

$$\sum q_j x_j + \sum q_i' e_i$$

[1] I do not mean that we have to introduce a linear re-statement in order to make use of the "weighted-average" concept of convexity. It is indeed obvious from the diagrams of Fig. 2 that we do not. It is possible (and useful) to re-state Paretian economics (with curved frontiers and indifference curves) in terms of convexity properties. This has been done, in a manner which should become classic, in the first of Tjalling Koopmans' *Essays on the State of Economic Science* (1957). I should like to take this opportunity of expressing the debt which I owe to that admirable work, which has had more effect upon the present paper than may appear on the surface. (The companion piece, that is mentioned in the previous footnote, did not appear until after this survey had been substantially written.)

where $q$ and $q'$ are new sets of price-weights; for the $e$'s could always be eliminated from the latter sum with the aid of the given equations. (It would then reduce to the familiar form $\sum p_j x_j$, with $p$'s depending on the given $q$ and $q'$ and on the given $a$'s.) The optimisation problem is therefore the same as the maximisation of a "weighted sum" of $s$ variables, *all* of which are to be non-negative, and which are connected by $t$ equations $(t < s)$.[1]

The "equational" formulation, which reduces all the restraints to sign restraints, at the expense of increasing the number of variables, is indeed that which is most commonly used in works on Linear Programming.[2] I have preferred to put the matter the other way, which (since it operates with fewer variables) offers more scope for geometrical illustration. Besides, the equational method is less obviously in touch with traditional economics. It is, however, well suited for some economic applications (as we shall see in a moment). There is much to be said for being ready to work either way.[3]

## IV. Linear Programming

Our sketch of the underlying theory is now complete; we can return to the story.

In order that Linear Programming should be born, two more things were necessary.

1. It had first to be realised that there are problems, other than the straightforward "economic" maximisation of the value of output from given resources, which are formally equivalent to economic optimisation. Opportunities, that is, for the application of the generalised theory (which has been described in the preceding section of this survey) had to be discovered. It is usual to associate this stage with two examples that have become classic—the "transportation problem" posed in 1941 by F. L. Hitchcock,[4] and the "diet problem," which was posed in a (still unpublished) paper by Jerome Cornfield that was circulated in the same year.[5] But it is probably more

[1] If $t > s$, and the equations are independent, the problem would be over-determined, and could not have a solution. If $t = s$, and the equations are independent, they will themselves determine a single solution, which will be the actual solution if it satisfies the sign restraints.

[2] The reason for this is mainly computational. If a problem is presented in inequality form it is easily converted into equational form by the introduction of "slack" variables (such as our $e$'s). The reverse process involves solving the equations, which may well be extremely laborious.

[3] If the primal variables ($x$) are completed by the introduction of the excess supplies of the factors, the dual variables ($u$) must be similarly completed by introducing the differences in the dual inequalities. These, in our prototype formulation, are the differences between cost and price—the *unprofitabilities* of the products, we may call them. When these are included the dual problem is in turn reduced to the minimisation of a weighted sum of $N$ variables, subject to sign restraints, and connected (now) by $N - M$ equations.

[4] In the *Journal of Mathematics and Physics*, Massachusetts Institute of Technology, Vol. 20, pp. 224–30.

[5] These have been described in innumerable places. There is a simple account in G. Morton, "Notes on Linear Programming," *Economica*, 1951; and a fuller in DOSSO, Chapters 2 and 5.

correct to regard these as no more than forerunners. The true begetters of Linear Programming were those who perceived the opportunities in question in connection with war production: Tjalling Koopmans, who rediscovered the transportation problem in connection with shipping, and G. B. Dantzig, who encountered similar questions in his work for the U.S. Air Force.[1] It was when Koopmans and Dantzig got together, after the War, that things really happened.[2] Here, however, we may content ourselves with a word about the conventional examples.

The *diet* problem—to determine the cheapest diet by which a minimum intake of given nutrients can be achieved—is very near to our prototype; indeed, when set out, it fits exactly into the prototype dual. (The amounts of nutrients in each food are the $a$'s; the quantities of foods are the $w$'s; the minimum intakes are the $p$'s; and the costs of the foods are the $b$'s. Every nutrient must be contained in some food, or—as is at once apparent—the problem cannot be feasible.) The *transportation* problem—to determine the cheapest pattern by which given demands of $m$ markets can be supplied from $n$ sources, with given unit costs of transport from any source to any market—is in a sense more interesting, since it is a beautiful example of a problem that sets itself up in terms of *equations* between non-negative variables. (The amount to be delivered from *each* source to *each* market has to be determined; these are connected by equations, since the total supply from each source, and demand from each market, is given.) Though some of the variables can be eliminated by means of the equations, so that it may be thrown back to the determination of $(m-1)(n-1)$ variables, connected by $m+n-1$ specific restraints, the choice of variables to be eliminated is very arbitrary; and though the initial unit costs are all positive, there is no guarantee that the same will hold for the coefficients which take their places, after elimination. Thus the transportation problem already requires the more general theory, while for the diet problem the prototype is sufficient.

2. The mere posing of these problems would not have been an advance, if there had existed no method by which the problems could have been solved. The main development in that direction was to follow a little later. It should, however, be made clear that, even before the invention of the Simplex method, the problems were *in principle* solvable; as soon as it is known that the optimum (if there is an optimum) must be at a vertex, or between *tying* vertices, identification of the vertices (and there was a rule for that) and calculation of the cost (as it was in these examples) at the vertices, would always lead to a solution *in the end*. With simple classroom examples, that is often by no means an impossible undertaking. But in any practical

[1] The influence of Leontief's work in demonstrating the practical applicability of one form of allocative theory, and in turning the attention of economists to a model in which produced commodities figure as inputs (this, as we shall see, itself means going beyond the Wald rules) also requires recognition.

[2] See their (indigestible) volume, *Activity Analysis of Production and Allocation*, ed. Koopmans (1951).

instance the amount of work to be done piles up very rapidly.[1] Even with the aid of computers (the simultaneous development of which has been a most important element in the practical success of Linear Programming), the solution of most real problems would still have been out of reach without the invention of better methods.

Any detailed discussion of such methods must clearly lie outside the scope of this survey. Reference must, however, be made to the Simplex method (discovered in 1947 by Dantzig [2]), which was historically the means by which this difficulty was sufficiently overcome to make Linear Programming a usable technique. Effectively, what the Simplex method provides is a means by which we can recognise an optimum when we have reached it; and by which, once any vertex (true vertex) has been identified, we can move from it in the *direction* of the optimum. It is itself a consequence of convexity. If one was trying to climb a mountain, and one knew that it was a convex mountain (without valleys or saddles), the shortest way of getting to the top would be to go straight up, from wherever one happened to be. That is (more or less) [3] what the Simplex method does—in $n$ dimensions!

The weakness of the Simplex method (as so far described) is that it requires the identification of some (true) vertex as a starting-point. Sometimes this can be found by inspection (for a problem which satisfied the Wald rules it would present little difficulty); but very often it cannot, save by luck. If it cannot, there is a preliminary investigation which must be carried through before the above process can start. Various methods have been suggested whereby this preliminary stage can be systematised; that which seems to be most generally useful is an adaptation of the Simplex method

[1] It may be useful to take an example from the transportation problem. If there are no more than 5 sources and 4 markets there are 20 variables to be determined; even after elimination, these cannot be reduced to less than $4 \times 3 = 12$ variables, subject to 12 sign restraints and $5 + 4 - 1$ specific restraints, 20 in all. The number of *possible* vertices is the number of ways in which 12 can be selected from 20; this is no less than 127,970. Thus if the thing were gone at bull-headed, more than an eighth of a million calculations, each of considerable size, would be necessary.

[2] Set out by that author in Chapter 21 of *Activity Analysis* (*op. cit.*). Versions are, of course, to be found in all the text-books.

[3] More accurately, it may be described as follows: As we have seen, any vertex $A$ is a solution of $n$ of the restraints (sign and specific) considered as equations. A vertex *neighbouring* to $A$ can be defined as one which is a solution of $(n - 1)$ of $A$'s equations, together with *one* of those which were not taken when $A$ was determined. ($A$ must, of course, be a true vertex, and the neighbouring vertices must be true vertices.) If $A$ is an optimum the value of $V (= \Sigma px)$ at $A$ must, of course, be no less than the value at any of the neighbouring vertices. It is less obvious, but it is true (as a result of convexity) that if $A$ is not an optimum there must be at least one of the neighbouring vertices where the value of $V$ is greater than it is at $A$. (This is the same principle as that which is familiar to economists, that—under universal diminishing returns—a maximum is sufficiently determined by looking at marginal conditions.) Thus in order to discover whether $A$ is an optimum it is only necessary to look at its relations with its neighbouring vertices. And in order to proceed as rapidly as possible to the optimum, from a given vertex, it is only necessary to select that one of the neighbouring vertices along the "edge" to which $V$ increases most rapidly; then to repeat the operation with the vertex so reached; continuing until a vertex has been found from which there is no increase to any neighbouring vertex. That is the Simplex method.

itself. By introducing extra variables into the original problem, a subsidiary problem can be written down which is such that: (1) a true vertex of the subsidiary can be found by inspection, and (2) an optimum of the subsidiary is a true vertex of the original problem. Thus the subsidiary can be solved by the Simplex method; once the subsidiary is solved, the Simplex method can be applied to the original problem without difficulty.[1]

Other methods are, however, in use. It is sometimes useful to begin by tackling the dual to the original problem; the dual can, of course, be written down immediately, and once the dual is solved, the primal can be solved at once. (An obvious case of this is when the primal has many variables but only two specific restraints; for the dual can then be reduced to two variables, and can be solved graphically.) There is also a Dual Simplex method, in which the dual is kept in sight all the time. A direct attack on the difficulty of finding a vertex from which to start is made by the "Multiplex method" (published in 1957 by Ragnar Frisch).[2] This requires only a feasible point (not a vertex) as a starting-point; from that it identifies a "centre" of the feasible region; if one moves from the centre, in the direction of increasing $V$, one should arrive somewhere near the optimum.

These are the basic tools which are at the disposal of the Linear Programmer; by these means a problem is soluble, if it can be cast into appropriate form, and of problems that can be so cast there appears to be an ample supply.[3] Most of them (like the diet problem and the transportation problem) are problems of the least cost method of carrying through a given programme; problems (both military and civil) of the public sector do often fall fairly naturally into that form. But since the coefficients in the weighted sum that is to be maximised (or minimised) may (when we have left the prototype) be either positive or negative, there is no reason why the determination of a maximum profit combination of inputs and outputs (prices of the inputs and outputs being given) should not be tackled in a similar way. Thus the uses of Linear Programming are not confined to the public sector, but can be extended, at least to some extent, to the field of private enterprise.

There is, however, a doubt which creeps in at this point; and it seems proper that in a survey like the present, such doubts should be mentioned. What is the relation between this new technique and the process of market adjustment by the price-mechanism, on which economists have been accustomed to rely for the solution of what are, after all, for the most part much the same problems? One can understand that there are problems of "economic maximisation" which are unsuitable, for social or institutional

[1] For a description of this device, see Gass, *Linear Programming*, pp. 61–66.

[2] It is briefly described by van Eijk and Sandee in *Econometrica*, January 1959, pp. 9–13.

[3] A fat bibliography has been published by Vera Riley and S. I. Gass (Johns Hopkins Press, 1958). It is summarised in nine pages at the end of Gass's book (above cited).

reasons, for solution by a competitive process; the " public sector " problems just mentioned are obvious examples of this, but no doubt there are others. Here, where the reason for the non-availability of the market mechanism is non-economic, it is an obvious gain to have found an alternative. What seems distinctly less clear is the usefulness of the technique in those cases which have so much troubled economists, where there are economic reasons why the market mechanism will not work. It looks only too likely that in these cases the Linear Programming technique will also be unsatisfactory.

Competitive theory (it has often been remarked by Linear Programmers) takes it for granted that the individual firm is maximising its profits; that, so they say, means that the Linear Programming problem, inherent in the firm's own production, has already been solved. That, they naturally maintain, is a big assumption. It has been shown by experiment that any complex problem of this sort requires a technique for its solution; without that technique it is too much to expect that the individual firm will be able to maximise its profits; now that the technique has been provided, the gap in the traditional theory can be filled. One would not deny the merits of this argument as a piece of salesmanship; but its deeper significance seems to come out more clearly if it is stood the other way up.

The traditional case for competition can be put into the form of saying that it is a way of avoiding the Linear Programming problem (the macro-problem, we might call it) which is involved in the co-ordination of production over the whole economy. The macro-problem is broken up, by the market, into little bits, each of which should be too simple to warrant the application of elaborate technique; the co-ordination between the bits (which would have otherwise to be provided by a supertechnician) is provided by the market mechanism. If this process were to be carried through fully there should be no scope for Linear Programming within the firm; for the firm's problem should be reduced to that of optimising against a set of restraints, so few and simple that the solution would be obvious. In practice, of course, the fragmentation is rarely carried so far as this; at the most, the market takes over a part of the task of co-ordination; a significant part is left to be done within the firm. The application of Linear Programming to business problems does therefore remain open as a useful possibility. We should, however, ask: why is it that the fragmentation does not proceed so far as to prevent this happening? What is it that stops the market from taking over the whole job?

Doubtless there are many reasons. But surely one should not overlook the reason which has, after all, most commended itself to economists: the diseconomies of small scale. Now if it is true that small-scale diseconomies are the main economic reason why fragmentation does not proceed to the limit it will follow that the same force which restricts the application of the market mechanism will also restrict the application of the linear technique. For the presence of scale economies implies the absence of convexity: some

qualification (which may be more or less serious) to the convexity which Linear Programming requires.

One is driven to the conclusion that Linear Programming and the price mechanism are rather close substitutes—both in the things they can do and in those they cannot. But the fact that two things are close substitutes does not exclude the possibility that there may be a part for each to perform.

## V. Activity Analysis

There is a wide sense of the term "Activity Analysis" in which it would include the whole of the theory (as opposed to the practical technique) of Linear Programming. I am using it here in a narrower sense, to which its title is (I think) more appropriate.

Let us go back to the prototype theory (which is subject to the Wald rules), and concentrate attention (this time) on its economic interpretation. As given so far, that economic interpretation was rather narrow. The prototype theory was presented as nothing more than a re-working of the Walras–Cassel system; the "fixed coefficients" and other basic restrictions, which notoriously limit the applicability of that system, were retained. It was, however, already shown by von Neumann [1] that there is an easy way in which they can be relaxed. All that is needed is a slight change in point of view.

It is convenient to begin with a rather special problem—that of products in joint supply. It is implicit in the Walrasian assumptions that the processes of production of the various products are *independent*: in the sense that the output of any product can be increased, by the absorption of additional units of the factors, without affecting the supplies of other products, except in so far as factors are withdrawn from the production of these other products. Though this independence assumption is not a bad approximation to reality, it is certainly not true universally; it is better, therefore, to do without it. There are indeed various ways by which that could be done.

It would, for instance, be possible to observe that joint supply relations can be reduced to (linear) equations connecting the various outputs ($x$); we have a regular technique for dealing with such equations. By their aid, for instance, some of the $x$'s could be eliminated; we could then proceed, with the remaining $x$'s, as before. That is the procedure which would be suggested by what has been said previously; but if we do proceed in that way, we are raising the question—what is the status of those $x$'s, which remain as variables of the system, after the others have been eliminated? They are outputs, but they are not all the outputs—they *represent* both themselves and the others. The notion accordingly presents itself that it will be easier to work, from the start, with indices of output, which are to be distinguished from the actual outputs of the commodities, and which will spare us the

[1] In the article above cited.

(arbitrary) choice of which variables to eliminate. It is from that idea that Activity Analysis arises.

An *activity* is a process whereby certain quantities of inputs are transformed into certain quantities of outputs. There are *constant returns to scale* (this is an essential assumption of Activity Analysis) so that an activity can be carried on at any *intensity*; by increasing the intensity, one simply increases all inputs and all outputs in the same proportion. Thus the $k$th activity, carried on at unit intensity, transforms $a_{1k}, a_{2k}, \ldots a_{Mk}$ of the factors into $\alpha_{1k}, \alpha_{2k} \ldots \alpha_{Nk}$ of the products; if carried on at intensity $X_k$ it transforms $a_{1k}X_k, \ldots a_{Mk}X_k$ of the factors into $\alpha_{1k}X_k, \ldots \alpha_{Nk}X_k$ of the products. (The $a$'s and $\alpha$'s are non-negative constants, which define the activity. Of course, where there is no joint supply, all but one of the $\alpha$'s will be zero.)

If there are $R$ activities, carried on at intensities $(X_k)$ the total input of the $i$th factor is $\sum a_{ik}X_k$ (summed over all $k$); the total output of the $j$th product is $\sum \alpha_{jk}X_k$ (summed over all $k$). Thus $V$, the total value of output (at prices $p_j$), is $\sum\sum p_j\alpha_{jk}X_k$ (summed over all $j$ and all $k$—all products and all activities); this may be written $\sum P_kX_k$, where $P_k$ (being $\sum p_j\alpha_{jk}$ summed over all products) is nothing else but the value of the output of the $k$th activity, when that is carried on at unit intensity. Everything can now be expressed in terms of the $X$'s. The sum to be maximised is $\sum P_kX_k$ (where the $P$'s, since they depend upon given $p$'s and given $\alpha$'s, are given constants). The specific restraints take the usual form

$$a_{11}X_1 + a_{12}X_2 + \ldots + a_{1R}X_R \leqslant b_1$$

$$\cdots \quad \cdots \quad \cdots \quad \cdots$$

$$a_{M1}X_1 + a_{M2}X_2 + \ldots + a_{MR}X_R \leqslant b_M$$

there are the usual sign restraints. Thus the whole of the prototype theory can be reinterpreted, so as to allow for the possibility of joint products, without requiring any formal (or mathematical) change.

That, I think, is the best way to introduce the "activity"; but the idea would be much less important than it is if it could only deal with joint products. As a result of this restatement, there is a further extension, much more far-reaching, which is automatically at our disposal. In the prototype theory, we maintained the Walras–Cassel assumption of the "fixed technical coefficients"—that there is just one way of producing each product, so that the $a_{ij}$'s are all constants. It may well have appeared that we were putting too much weight upon this assumption (it was, after all, abandoned long ago by those who worked in the Walras tradition [1]); it was nevertheless convenient to maintain it, for purposes of exposition, and it was safe to do so, because it would be so easy to abandon it when the time came.

The Activity Analysis model, just described, is in fact no longer tied down by the assumption of fixed technical coefficients. Just as the possibility was left open, in the prototype, that some possible products would not be pro-

[1] By Walras himself in his last edition; by Pareto already in the *Cours* (1898).

duced; so it is left possible here, for exactly the same reason, that some possible processes (for a product that is produced by another process) will not be employed, so that the intensities of these processes ($X$) are zero. The condition for this to happen can be worked out at once from the condition for zero output in the prototype. The intensity of the $k$th activity will be zero if $P_k < \sum w_i a_{ik}$; that is to say, if the activity is unprofitable at the imputed factor prices. Thus, while some of the disused activities will represent products that it does not pay to produce, others (and probably in practice these will be the more interesting) will represent methods of production that it does not pay to employ. Accordingly, by a sufficient widening of the range of possible activities, everything which economists are in the habit of saying about factor substitution can be brought in.

It must be emphasised that the resulting model is mathematically identical with our prototype model; the Wald rules are still in force; all that has happened is that it has been given a different economic dress. Nevertheless, by that simple change it has been converted into a general theory, with a range which is comparable to that of the Paretian theory of general equilibrium. The Activity Analysis approach is indeed in the end not so dissimilar from the Paretian approach; their strengths, and their weaknesses, are much the same. We get no help from Activity Analysis in dealing with increasing returns, the nut which is hardest to crack by Paretian methods; indeed, it may be said that the Activity Analyst is more completely dependent upon the hypothesis of constant returns to scale than the Paretian. There is nothing to prevent the Paretian from exploring the realms of increasing returns, to the very limited extent to which they can be explored by his methods; to the Activity Analyst they are forbidden territory. Each is beset by the temptation to make excessive use of the price parameters, which are associated on the one side with the assumption of perfect competition, on the other with convexity assumptions, which amount (in practice) to much the same thing. The possibility of methods that it does not pay to employ can be dealt with on either method; where Activity Analysis gains is in its more explicit attention to the possibility of products that it does not pay to produce, and of factors that it does not pay to use. For any problem where these latter possibilities are not important (and that is surely the case with the majority of economic problems) it will not matter which method one uses. If either is applicable, both will be applicable; each will give the same results.

This being so, it is not surprising to find that particular problems, for the solution of which the new method has a decided advantage, are far from common. It can indeed happen—it is already happening—that people who have learned to think in the new way will begin by getting their problems out in that way; but it usually appears in the end that they could have been got out in the old way just as well.[1] This is not to deny that there are things

[1] A nice example is to be found in the papers by Farrell and Champernowne (*Econometrica*, July 1954).

which it is easier to notice if one is thinking in the new manner; one wonders whether Samuelson would have put forward his famous Factor-price Equalisation Theorem just when he did, if he had not been working, at the same time, at the development of Activity Analysis.[1] It would, however, appear that (apart from Input–Output applications, which I shall be considering in the next section) the principal achievement of the new method has been the establishment of very general theorems, which are mainly valuable because, when we have them, we can go on in our old ways with a better conscience. The chief of these is the proof of the existence of a competitive equilibrium (the solution of Wald's problem) which is contained in a most remarkable passage of the DOSSO book.[2] The general character of this proof (too important a matter to be omitted from this survey) may be sketched out, very roughly, as follows.

From the Wald rules about the constants—$a$'s, $b$'s and $p$'s (or $P$'s)—which are carried over into Activity Analysis, it follows (as we have seen) that production is optimisable; there is a set of quantities of products ($x$) which maximises the value of output for given product prices ($p$), and there is a set of imputed factor prices ($w$) which belongs to that optimum. If production is organised (as it should then be possible for it to be organised) into firms which operate under perfect competition, the earnings of the factors will be such as correspond to these imputed factor prices. Thus on the "supply" side the equilibrium exists; but nothing has yet been said about the demands for the products. These must now be brought in. All we assume, at this stage, is that the demands depend, in some way, upon the product prices and factor earnings; then, since the factor earnings depend on product prices, both the demands ($x'$) and the supplies ($x$) of the products have been shown to depend upon the product prices ($p$).[3] The difficulty is to show that there must be some set of product prices which makes demands equal to supplies. This is tackled in the following way.

Starting from any arbitrary set of product prices (and derived factor prices), we have an ($x'$) determined by the demand functions; but this ($x'$) may not be feasible, or, if feasible, it may not be efficient—there may be no ($p$) for which it would be optimum. What DOSSO then does is to diminish (or increase) all the $x'$ in the same proportion, until the resulting set of quantities, $k(x')$, does lie on the frontier of the feasible region. To this $k(x')$ there will correspond a set of prices ($p'$), being a set of prices for which $k(x')$ is an optimum. (Usually, indeed, as when $k(x')$ is at a vertex, there will be many such sets of prices; but that does not—too much—matter.) These

[1] There is a family resemblance between the Factor Price Theorem and the Input–Output Substitution Theorem (see below, p. 703) due to the same author.

[2] Pp. 366–73. It appears that in its final form this proof is due to Solow; but it was built up by stages, that are to be associated with the names, first of Wald himself, then of Lionel Mackenzie, of Samuelson and of Harold Kuhn. (There is another discussion in Baumol, *op. cit.*, pp. 859–65.)

[3] The ($p$) are, of course, to be understood as *relative* prices; if all $p$'s, and consequently $w$'s, are multiplied by the same multiplier, they will generate the same ($x$)—and the same ($x'$).

($p'$) prices are rather analogous to "supply prices," to be put against the "demand prices" ($p$) with which we began.

A rule has therefore been evolved by which a set (or sets) of supply prices can be associated with the given demand prices. At this point it is possible to invoke the aid of a powerful mathematical tool, *the fixed-point theorem*,[1] according to which (provided that a number of conditions, which can be shown to hold in this case, are satisfied) there must be some ($p$) which is itself included among the sets of ($p'$) which, in this manner, it generates. Once that is established, the rest is simple. For since the total earnings of the factors (which, by "Walras' law," are all spent) are equal to the total value of output,[2] it follows that at this ($p$), $\sum px' = \sum p(kx')$. Since the $k$'s are the same for all products, $k = 1$. The quantities demanded are optimum quantities; supplies and demands are equal. Thus the competitive equilibrium exists.

The most interesting thing about this proof, to the economist, is the little that has to be assumed about the demand functions.[3] It is necessary that there should be some set of demands, some ($x'$), that is generated by every ($p$) and the ($w$) that belongs to it; but little more is necessary.[4] There is nothing that corresponds to the "downward slope of the demand curve." The explanation of this rather surprising omission is that nothing has been said about the uniqueness of the equilibrium. Multiple equilibria are perfectly possible. Sufficiently strong "downward slope" assumptions (what Samuelson calls "the weak axiom of revealed preference"—what I should prefer to describe in terms of the absence of net-income effects) do, however, prove uniqueness. That is where they come in. It is, of course, familiar, from simple examples, that the presence of net-income effects may lead to such things as "upward sloping demand curves" and multiple equilibria.

## VI. Input–Output

Throughout our discussion of Activity Analysis we have maintained the Wald rules; with the implication, which they carry, that factors and products (inputs and outputs) are fundamentally different sorts of things. Analysis

[1] The general idea of a fixed-point theorem is well explained in Courant and Robbins, *What is Mathematics?*, pp. 251–5. It should, however, be noticed that what is there described is the original Brouwer theorem, not the slightly more complicated Kakutani theorem, which is what is needed for the above purpose. See the passage in DOSSO, just cited; also Baumol, p. 859.

[2] See above, p. 684.

[3] It is quite unnecessary to make the peculiar assumption, which Wald made in 1934, that demands do not fall to zero, however high prices rise. As Kuhn has shown in the paper that was previously mentioned (*Linear Inequalities*, *op. cit.*), the reason why Wald made this assumption was that he did not have the duality theory. He took it for granted that all of a *given* list of outputs must have prices equal to costs; and that meant that he had to exclude the possibility of zero outputs. Though he allowed for the possibility of factors with zero prices, he did not allow for the other zero, which is dual to it.

[4] It has to be assumed that the demand functions are continuous—that there are no jumps in demand as prices change. This is necessary, if we are going to insist on making it a condition of equilibrium that demands should *equal* supplies. If we were prepared to be content with some sort of approximate equality this continuity condition could presumably be loosened a bit.

of that kind can deal with most aspects of a static system (under constant returns to scale); but it cannot deal with intermediate products, which are outputs from one angle and inputs from another. What it must be assuming about such products is that they have been " netted out " by vertical integration. It is, however, uncertain whether actual production is capable of such integration, without being involved in lateral integration also; in any case, the intermediate products which certainly exist are worthy of study on their own account. It will not be expected that any very serious discussion of the Input–Output theory, invented by Leontief as a means of studying such linkages,[1] can find a place at the end of this already lengthy survey; it has, however, proved so attractive a field [2] for the application of the developments which we have been considering that it cannot be left altogether on one side.

It is characteristic of Leontief's model that it reduces the primary factors to one only—homogeneous labour; apart from labour, the inputs of each industry are the outputs of other industries. We define $x_i$ as the *gross* output of the $i$th commodity, including that which is absorbed as inputs of other industries, or indeed (for the seed-corn must come out of the harvest) as input in the production of $x_i$ itself. The amount of the $i$th commodity which is needed as input of the $j$th (per unit of the latter) is taken as given, like the corresponding coefficients in the prototype; it will cause no confusion if we write it $a_{ij}$, as before. The demand for the product $x_i$, as input in the production of other commodities, will then come to $\sum a_{ij}x_j$ (summed over all $j$); the net, or final, output is the difference between this and gross output, that is to say, it is $x_i - \sum a_{ij}x_j$. The amount of labour that is required (per unit of product) for the $j$th product we will simply write $a_j$. Then the demand for labour is $\sum a_j x_j$ (over all products).

What are the restraints under which this system operates? There are, of course, first of all the usual sign restraints (all $x_i$ non-negative). If we suppose that the supply of labour ($b$) is given, we have a specific restraint, of the usual kind, due to the limitation of the supply of that factor; here it will appear as $\sum a_j x_j \leqslant b$. It is, however, further necessary that the *net* outputs of the products should be non-negative. It is possible, that is, for the whole output of a particular product to be absorbed as inputs in the production of other products; but it is inconsistent with static equilibrium for more than the whole output to be so absorbed. Thus we have another set of specific restraints, of the form $\sum a_{ij}x_j \leqslant x_i$ (for all $i$), or, written in full,

$$a_{i1}x_1 + a_{i2}x_2 + \ldots + (a_{ii} - 1)x_i + \ldots + a_{in}x_n \leqslant 0$$

It is the appearance of these " Leontief restraints," as we may call them, in

[1] *Structure of the American Economy* (1st ed., 1941; 2nd ed., 1951); *Studies in the Structure of the American Economy* (1953). I have made extensive use of the chapters on Input–Output in DOSSO (IX and X); it does, however, take some effort to disentangle from these chapters the essential points.

[2] As will be apparent to anyone who turns the pages of *Econometrica* or the *Review of Economic Studies*, it is one of the fields of application on which interest has been centred in the most recent years.

addition to the labour restraint, which marks the Leontief system off from those we have considered hitherto.

It may be assumed, for the same reasons as before, that the $a$'s (of every kind) are non-negative; but that cannot mean that all of the coefficients in any Leontief restraint can be non-negative. If they were, it would follow at once (because of the zero on the right-hand side) that outputs of all commodities with non-zero coefficients must be zero. For the Leontief system to be feasible at all, it is first of all necessary that the " feedback coefficient " $a_{ii}$ (of any output into its own production) should be less than unity. But that means that we are bound to have one negative coefficient in each of the

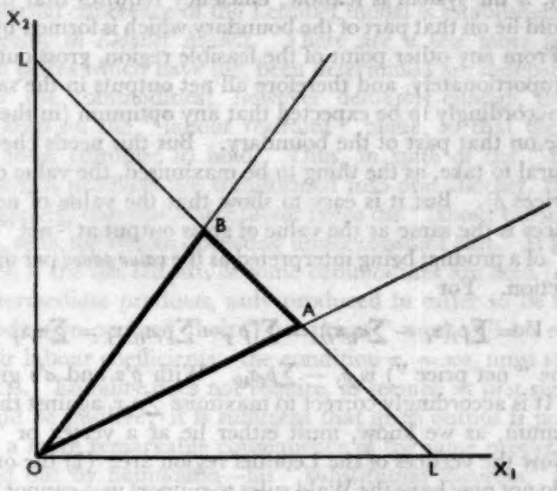


FIG. 3

Leontief restraints; accordingly, the Wald rules, and their consequence—assured feasibility—will not apply.

The situation which emerges can easily be illustrated diagrammatically (Fig. 3). If gross outputs $x_1$ and $x_2$ are measured on the two axes, the labour restraint will appear as a downward sloping line of the usual kind ($LL$); while the Leontief restraints will appear as upward-sloping lines (because of the negative coefficient) through the origin (because of the zero on the right-hand side). The feasible region is accordingly cut down to the triangle $OAB$. Evidently it will continue to take the same sort of form—a pyramid or " cone " with apex at the origin—in more than two dimensions.

There are two things, which are already visible in this construction, which require to be noticed. In the first place, the mere condition that $a_{ii} \leqslant 1$ (which keeps the Leontief lines upward sloping) is not sufficient to ensure that there exists a feasible region. The line $OA$ could easily be swung up (or $OB$ swung down) so that the feasible region disappeared. What this

would mean (in the two-goods case) is that the amount of $x_2$ absorbed in making $x_1$ was greater than could be replaced by absorbing all of the $x_1$ in the $x_2$ industry (so that if net $x_1$ were zero, net $x_2$ would still be negative); with $a$ coefficients chosen at random that would certainly be possible, and it would certainly mean that the system would not work. The same thing can naturally happen in more complicated ways when there are more than two commodities. The conditions (upon the $a$ coefficients) for it *not* to happen are called the Hawkins–Simon conditions; [1] it is unnecessary to write them out here. It is sufficient to observe that some such conditions must be satisfied if the Leontief system is to be feasible.

Secondly, if the system is feasible, efficiency requires that the "point" selected should lie on that part of the boundary which is formed by the labour restraint. From any other point of the feasible region, gross outputs can be increased proportionately, and therefore all net outputs in the same proportion. It is accordingly to be expected that any optimum (in the sense so far used) will lie on that part of the boundary. But this needs checking up.

It is natural to take, as the thing to be maximised, the value of *net* output (at given prices $p$). But it is easy to show that the value of net output at "gross" prices is the same as the value of gross output at "net" prices—the "net price" of a product being interpreted as the *value added* per unit of output in its production. For

$$V = \sum p_i(x_i - \sum a_{ij}x_i) = \sum(p_j - \sum p_i a_{ij})x_j = \sum \pi_j x_j$$

where $\pi_j$ (the "net price") is $p_j - \sum p_i a_{ij}$. With $p$'s and $a$'s given, the $\pi$'s are given. It is accordingly correct to maximise $\sum \pi_j x_j$ against the restraints.

An optimum, as we know, must either lie at a vertex or "between" vertices. Now the vertices of the Leontief region are: (1) the origin, which —since we do not now have the Wald rules to support us—cannot be excluded as a possible optimum; (2) the points such as $A$, $B$ on the diagram, which are intersections of Leontief restraints with the labour restraint. At the origin, however, $V$ is necessarily zero, while at the latter vertices $V$ will necessarily be positive [2] (if there is a feasible region), so that it is only the latter vertices which we need consider. Each of these vertices will represent a position in which there is a zero net output of all but one of the commodities, and a maximum net output of the one that remains. Possible optima (all of which, it is now confirmed, must lie on the labour restraint part of the boundary) are weighted averages of these vertices.

If there are positive net outputs of all the $n$ commodities, $V$ must have an equal value at all of these vertices, so that $\sum \pi_j x_j$ must be the same all over the "plane" $\sum a_j x_j = b$. This can only happen if $\pi_j$ bears the same proportion to $a_j$ for all commodities. This we may write $\pi_j = wa_j$, where $w$ is

[1] They were worked out, with a little trouble, by the eponymous authors, in *Econometrica* during the year 1949.

[2] We keep the "extra" Wald rule, that the $p$'s are non-negative, and not all zero.

easily recognisable as the (imputed) price of labour. Thus we have $n$ equations

$$p_j - \sum p_i a_{ij} = wa_j \quad \text{(for all } j\text{)}$$

to determine the gross prices ($p$) relatively to the wage of labour. It will only be at these prices that the net outputs of all $N$ commodities can be positive.

How do we know, it may, however, be asked, the prices ($p$) that are determined by these equations will be non-negative? It turns out that the conditions for this to be so are the same Hawkins–Simon conditions as we had formerly to invoke to establish feasibility. Thus, granted these conditions, the internal coherence of the Leontief model is established.

*Substitutability in Leontief Models.* There are a few more points to be noted. The prices which have just been determined are independent of the demands for the commodities; however demands change, the optimum point must keep on the "labour restraint" plane, so that the prices just determined must continue to hold. Thus, in spite of the "fixed coefficients" at which products are transformed into one another, the fact that there is (ultimately) only one scarce factor keeps the "labour theory of value" in operation, with the system operating under constant cost. It follows from this that even if the net outputs of some commodities are zero (so that they are pure intermediate products, only produced in order to be re-absorbed into the productive process) their "net prices" must still be equal to the value of their labour coefficients: the condition $\pi_j = wa_j$ must still hold for such products. Equality does not require, as seemed at first sight, that net output should be positive; it is sufficient that gross output is positive.

There is a more remarkable consequence of the same property, that has been pointed out by Samuelson—his "substitution theorem."[1] It is not necessary, in the Leontief model, to start, as hitherto supposed, with given technical coefficients—given methods of producing the commodities. There may be a choice of methods, and it will yet follow that there is one method which has to be adopted for each product; the method chosen is independent of the demands for the products. Thus the Leontief system produces under constant cost, even if methods are (in principle) variable.

This, it will be recognised, is again a generalisation of the labour theory of value. If all labour was applied directly to the making of finished products (and labour was the only factor), there might be a choice of methods, but efficiency would dictate that the most efficient method should be used for each product—as Marx (for instance) knew very well. The choice of method would be independent of the demand. What Samuelson has shown is that the same continues to hold, so long as labour is the only primary factor of production, even if labour is applied indirectly as well as directly. Put in this way, his result is by no means surprising.

[1] Originally stated in Chapter VII of *Activity Analysis* (ed. Koopmans).

There is, however, an exception to the classical doctrine, that has been familiar since the days of J. S. Mill. If some of the products are joint products, the relative prices of the joint products will depend upon demand; it is then possible that a shift in demand will lead to the substitution of one method of production for another, even though labour is the only primary factor. The Leontief system excludes such joint production, so that in the Leontief system this complication cannot arise. It is, however, to be expected that it will arise if we attempt to extend the Samuelson principle to cases in which joint production is allowed.[1]

It may be useful to show in detail how this is. In terms of Activity Analysis, the general problem may be posed as follows: There are $R$ activities, capable of producing the $N$ commodities (by input of some and output of others, and, of course, by input of labour). Since the activities include many alternative possible methods of producing the commodities, $R$ may be supposed to be larger—if we like much larger—than $N$. We may generalise our notation, and write $\alpha_{ik}$ as the *output* of the $i$th commodity by the $k$th activity, when it is operating at unit intensity; inputs can be covered by the same symbol, $\alpha_{ik}$ being negative when the $i$th commodity is an input. Here we will write $\beta_k$ for the input of labour. Then, if $X_k$ is the intensity of the $k$th activity, the net output of the $i$th commodity, over the whole system, is $\sum\alpha_{ik}X_k$. We have to maximise $\sum\sum p_i\alpha_{ik}X_k$, subject to the restraints: $X_k \geqslant 0$ for all $k$; $\sum\alpha_{ik}X_k \geqslant 0$ for all $i$; $\sum\beta_kX_k \leqslant b$. Formally, the problem is almost the same as before. Since some $\alpha$'s are positive, and some negative, there is still the same question of determining whether or not there exists a feasible region; in order that it should exist the $\alpha$'s will have to be suitable. We will suppose that they are suitable.

Following the same argument as before, it would be necessary, if all activities were utilised, that $\sum p_i\alpha_{ik} = w\beta_k$ for every activity. But this gives us $R$ equations to determine $N$ prices; if $R > N$, as we have supposed, the system is over-determined.[2] Thus, in general, it will not be possible for more than $N$ activities to be utilised; the rest will have $\sum p_i\alpha_{ik} < w\beta_k$, and intensity zero. Optimisation involves the selection of a particular set of not more than $N$ activities, which are to be employed; an optimum set of activities must satisfy the conditions just stated. If the optimum set consists of the whole number of $N$ activities the prices at which these activities can be employed will be determinate; any demands for final outputs which the system is capable of satisfying can be satisfied at these prices and with these activities. Now if there is no joint supply, at least $N$ activities will be required to produce the $N$ commodities; this therefore is Samuelson's case.

[1] The point of the elaborate investigations by Koopmans and Arrow (Chapters VIII and IX of the *Activity Analysis* volume) was to clear up this exception.

[2] This assumes (and it is assumed throughout the argument) that the activities are "linearly independent"—that we are not including any activity which is a mere combination of other activities. In economic applications that (I think) may be taken for granted.

But if there is joint supply it will be possible for the $N$ commodities to be produced in positive quantities with less than $N$ activities; the prices are then not determinate, and it is possible that as demands vary, the activities that are utilised may change.

The matter may be illustrated, and the argument made more precise with the aid of a diagram (Fig. 4). Suppose that there are two commodities being produced and three possible activities: $N = 2$ and $R = 3$. Measuring the intensities of the activities along three axes, the labour restraint becomes a plane; as we have seen, the optimum must lie upon that plane: let us therefore take it to be the plane of the paper. The intersections of this plane with the co-ordinate planes will accordingly appear on the paper as a triangle $XYZ$. The sign restraints and the labour restraints limit possible optima to points within or on the sides of this triangle. The *two*

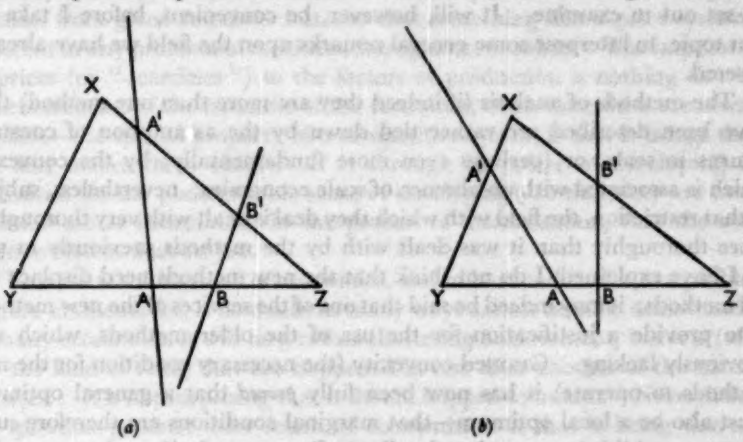


FIG. 4

Leontief restraints (which will also be shown as straight lines—the intersections of the Leontief planes with the labour plane) will limit the possible optima further. If they are to be operative at all they must intersect the triangle: there are then two main cases, in one of which they intersect the same two sides (Fig. 4 (*a*)); in the other there is only one side which they both intersect (Fig. 4 (*b*)).

Now in either case, for the reason above stated, it is not possible that all three activities should be used in an optimum position; the optimum cannot therefore lie *within* the triangle $XYZ$; it must lie *on* one of the sides. Accordingly, in Fig. 4 (*a*), possible optima lie along $AB$ or along $A'B'$; one of these stretches will be more efficient than the other. If it is $AB$ the system will be at $A$ when the demand for one commodity is zero, at $B$ when the demand for the other is zero; they can be combined (efficiently) in any proportions by moving along $AB$.

In this case, therefore, the Samuelson theorem is verified; but now consider Fig. 4 (*b*). Possible optima now lie along *AB*, or along the broken line *A'XB'*. If *AB* is optimum, all is as before; but if the other is the optimum stretch there is a change in the combination of activities as demand varies from one extremity to the other. But this exception can only arise if the point *X* is on the optimum path—if positive net outputs of the *two* commodities can be secured by using only *one* activity. Joint production is accordingly a necessary condition for the exception to arise.

## VII. Conclusion—The Theory of Games

There remains one further topic which needs consideration before we have exhausted the list of specialisms which, in their relations to one another, we set out to examine. It will, however, be convenient, before I take up that topic, to interpose some general remarks upon the field we have already covered.

The methods of analysis (if indeed they are more than one method) that have been described are rather tied down by the assumption of constant returns to scale, or (perhaps even more fundamentally) by the convexity which is associated with an absence of scale economies; nevertheless, subject to that restriction, the field with which they deal is dealt with very thoroughly, more thoroughly than it was dealt with by the methods previously in use. As I have explained, I do not think that the new methods need displace the old methods; it may indeed be said that one of the services of the new methods is to provide a justification for the use of the older methods, which was previously lacking. Granted convexity (the necessary condition for the new methods to operate) it has now been fully *proved* that a general optimum must also be a local optimum—that marginal conditions are therefore sufficient to establish its general optimality. Consequently if one is prepared to grant (as in many cases one is) that the changes one wants to consider will not involve any change in the number or specifications of the kinds of goods that are to be produced, or of the resources that are used, the old-fashioned marginal rules are all that have to be considered. The occasions on which the economist will want to go further, so as to have to use the new methods in relation to particular problems (while being able to retain the convexity conditions which enable him to use them) are really rather infrequent.

It must nevertheless be recognised (and this is the point on which I now want to lay stress) that the new methods are a great advance upon the old in the understanding which they convey of the *raison d'être* of the price mechanism. The rather inappropriate mathematical methods, which have been employed (at all levels of mathematisation) by the school of Cournot and Walras—and of Marshall—did in this respect rather let us down. For they caused it to appear that the price system is just one way of organising an economy efficiently; that it is, in a sense, exterior to the economic

problem, something that is brought in from outside. What the linear theory has shown—and this, speaking as a theoretical rather than as a practical economist, seems to me to have been its greatest service—is that, so long as the convexity assumptions hold (and though I have constantly emphasised that they do not hold universally, I would certainly admit that they hold, to a fair approximation, over a large part of the economic field), the price mechanism is something that is inherent. It did not have to be invented, or brought in from outside. It belongs.

This indeed is what was first perceived, after a fashion, by Menger and his followers; but they did not have the power of explaining, in a manner which would compel communication, the truth that they had seen. Now it has all been set down in black and white. It has been made apparent, not only that a price system is inherent in the problem of maximising production from given resources but also that something like a price system is inherent in any problem of maximisation against restraints. The imputation of prices (or " scarcities ") to the factors of production is nothing else but a measurement of the *intensities* of the restraints; such intensities are always implicit—the special property of a competitive system is that it brings them out and makes them visible. It is through its power of developing the intensities (in the photographic sense of developing), so that they are available for use as instruments in the process of maximisation, that the competitive system does its job.

To have taken so much of economics, and to have reduced it to a problem in pure mathematics, is no doubt in many ways a most notable achievement; to many economists it will be a rather shattering achievement, but it is (after all) the kind of thing that has happened in one after another of the natural sciences. It is not surprising that it should happen to us also. Nevertheless, the question persists: how much of economics is it that is being thus absorbed? If we take the famous definition, given so many years ago by Lord Robbins—" the relationship between ends and scarce means that have alternative uses " [1]—economics, in that sense, is very well covered by the linear theory. It has, however, been shown that in that sense it has very little to do with " human behaviour "—a phrase that Robbins did allow to creep in. The " logic of choice," now that it has been fully mathematised, appears as nothing else but pure technics—the distilled essence of a general technology.

Economics, surely, is a social science. It is concerned with the operations of human beings, who are not omniscient, and not wholly rational; who (perhaps because they are not wholly rational) have diverse, and not wholly consistent, ends. As such, it cannot be reduced to a pure technics, and may benefit by being distinguished from a pure technics; for we can then say that its concern is with the use that can be made of pure

[1] *Nature and Significance of Economic Science*, p. 15. The "Austrian" credentials which are presented in the footnote to that page should be noticed.

technics by man in society. And that looks like being a distinctly different matter.

But is it? Here I come to my last topic, on which I propose to be brief. In the Theory of Games we have a subject (evidently related to those which we have been discussing, at least in the sense that it uses some of the same mathematics) which is specially concerned with the analysis of behaviour when ends are different, either completely or partially opposed. Are we to say that the rest of economic theory, which is not pure technics, is nevertheless capable of being treated in much the same way by the sister subject—the Theory of Games?

I do not pretend to know the answer to that question. I am not equipped to answer it; the Theory of Games now covers a vast territory, and there is far too much of it that I make no pretence of understanding. I shall confine myself to one point which I think I do see clearly—namely that the relation of economics to the Theory of Games is an entirely different matter from those which we have been discussing. There is no doubt that the theory of optimisation (whether or not it *is* economics) is highly relevant to economics; it may well be that the Theory of Games is highly relevant; but one does not follow from the other.

This is worth stating, because it is easy to get the impression that the connection is closer. One of the neatest ways of proving the general Duality theorem [1] (which, it will be remembered, has not been proved in this paper) is to develop it as a consequence of the fundamental theorem of Game theory —the Minimax theorem, as it is called.[2] If this is done, it looks as if the theory of optimisation is being swallowed up by Game theory—as if the Theory of Games was not merely swallowing that part of economics on which it has obvious designs, but was ready to absorb the lot! But that, I am convinced, would be a mistake.

Though the Minimax theorem is usually stated as a theorem in Game theory (and no doubt it is that application which to mathematicians is the most fruitful), it is not necessary to state it that way. It can easily be stated in a more abstract manner—as a pure property of numbers that are arranged in a rectangular matrix. Any such matrix has a minimax (the minimum of row maxima) and a maximin (the maximum of column minima). It is easy to prove that the minimax must always be greater than, or equal to, the maximin. What von Neumann's Minimax theorem states is that there is a process of " enlarging " the matrix by which the gap between minimax and maximin (if it initially exists) can be so reduced that it ultimately disappears. This process of enlargement is simply the addition of new rows and columns which are weighted averages (in the sense in which we have been using that term) of the former rows and columns. By sufficient enlargement, minimax and maximin can be brought together.

[1] See above, p. 687.

[2] See, for instance DOSSO, Chapter 16.

What I want to emphasise is that this enlargement is a purely abstract operation, which can be given all sorts of meanings, that have nothing but a formal connection with one another. When the Minimax theorem is used as a means of proving Duality the matrix is a matrix of technical coefficients; the enlargement (in one direction) is carried out by varying outputs, in the other by varying factor prices. When it is used in Game theory the matrix is a matrix of pay-offs; the enlargement is performed by mixing strategies. The mixing of strategies has nothing necessarily to do with the Minimax theorem; it is one of the ways in which the theorem can be applied, and no more. That the Minimax theorem can be used in the theory of optimisation does not show that " Outputs *v.* Factor Prices " is in any sense a Game.

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## BIBLIOGRAPHICAL NOTE

So much bibliographical work has been done by others upon the subjects covered in this survey that there is no case for appending to it a formal bibliography. The wants of mathematicians and of Linear Programming technicians are catered for in the bibliography to Gass, *Linear Programming* (1958). There is a more selective bibliography, more directed to economists, in DOSSO (Dorfman, Samuelson and Solow, *Linear Programming and Economic Analysis*, 1958). The further reading that can be recommended to the non-mathematical economist is, however, rather limited; most of it has been mentioned already.

For an easy introduction, there is G. Morton, "Notes on Linear Programming" (*Economica*, 1951); with W. J. Baumol, "Activity Analysis in One Lesson" (*A.E.R.*, 1958) to follow. Valuable background is provided by Koopmans' introduction to *Activity Analysis of Production and Allocation*, and by the first essay in his *Essays on the State of Economic Science* (1957). After these, there is nothing for it but to plunge into the DOSSO book, so frequently mentioned.

On the side of technique, Charnes, Cooper and Henderson, *An Introduction to Linear Programming* (1953) remains the simplest account of the Simplex method; it should, however, be noticed that it is the original method that is there described, not the revised method, making use of the " subsidiary," that is mentioned on p. 692 above. If one uses DOSSO for this purpose, there is much to be said for beginning with their chapter on the transportation problem. It should however be recognised that the technique of linear programming is a practical subject, like practical statistics or practical accounting; though it can be taught in classes to students of quite average intelligence, it is a tiresome thing to work out for oneself from a book.

# MONETARY THOUGHT AND MONETARY POLICY IN ENGLAND[1]

THE purpose of this paper is to review certain basic notions that have underlain English monetary policy during the nineteenth and twentieth centuries. I shall contend that the theoretical approach to the problems of policy needs redirecting in the light of changes in the institutional and political environment. I have nothing revolutionary to say and, restricting myself to the more elementary aspects, I shall throughout emphasise theory rather than the course of events.

In some of the more lively phases of monetary controversy during the last 160 years the front of the stage has been occupied by questions of the foreign exchanges and the balance of payments, but even in these phases discussions of practical policy have more or less explicitly assumed certain views on internal policy; indeed, the classical contribution of English thought was the insistence on the connection between the internal and external objectives of monetary policy. At other times, when attention has been focused on troubles common to many countries rather than disturbances in the monetary relations between countries, considerations most relevant to a closed system have naturally come to the forefront. It is with these internal aspects that I am directly concerned—remembering always, however, the sound tradition that we separate the internal from the external at our peril.

Throughout the period—we can date it from the Bullion Report of 1810—the broad approach of every generation has been a Quantity Theory approach. I take this in the most general sense of a belief that the value of money is dependent, to an important extent, on its quantity, and that therefore some control of the supply of money is an essential prerequisite of any sensible monetary policy. The Quantity Theory, in all its simplicity, has great attraction. It is a supply-and-demand analysis, with a demand schedule whose peculiarity derives directly from the concept of money not as an object of exchange but as the medium of exchange. That this is only a small part of the truth is acknowledged even by those economists who rate it most highly, and I should be guilty of travesty if I were to accuse authoritative writers of allowing the Quantity Theory to monopolise their thoughts on monetary action. But I am going to suggest that we should all have a clearer view if we went back to the starting-point and looked afresh at the basic concepts. We must go back to the nature of money and the demand for it.

The word "money" is used in two senses. Money is the standard by which we measure the exchange values of things and in which debts are

[1] Presidential Address to Section F of the British Association for the Advancement of Science at Cardiff, September 2, 1960.

denominated. This is the abstract sense in which we use the term; we know what pounds, shillings and pence are, in the sense that we know they are the units in which debts and prices are stated. We run into difficulties —the familiar index-number problem, on which I shall not comment— when we begin to generalise about " the value of money," still using the word " money " in this abstract sense, but at least there is no doubt about what is the " money." When we say that our economic system has acquired its present shape on the basis of a general assumption that the value of money is reasonably stable, it is of this abstract sense that we are thinking. Yet when we say that, in order to achieve this stability in the value of money, we must control the supply of money, we have switched away from the abstract sense of money to its other, concrete sense. For by " control of the supply of money " we mean control of the availability of certain assets which are used as media of exchange and stores of value. We have switched from an unambiguous abstraction to a class of marketable objects whose boundary has neither sharpness nor certainty nor permanence. And we have arrived at one of the perennial questions of controversy: the question of what assets are, and what are not, included in the " money " category. I suspect that, because money in the abstract sense is an unambiguous concept, people have subconsciously believed that there must also be a simple answer to the question of what is money in the concrete sense. They have been looking for a sharp line of distinction where only Marshallian shading has reality. This pursuit of a will o' the wisp has had its effects on discussions of policy, for people have been too ready to believe that there is an identifiable quantity the control of which is all-important.

The difficulty of identification has derived from the twofold nature of money (we are now speaking only of the concrete sense) as a medium of exchange and as a store of value. Money is both these. An asset which entirely ceases to be a store of value ceases to be used as a medium of exchange, as has been seen when a money is rejected in the final stage of hyper-inflation. There are articles which are stores of value but are clearly not money because they are *never* used as media of exchange. But are we to label as money all other stores of value, that is to say all those which are ever brought into use, whether commonly or occasionally or only rarely, as media of exchange? The usual answer is that we should include as money only those assets which are commonly used as media of exchange. Resort to the adverb " commonly " at once emphasises the absence of any sharp line of distinction. Are balances in a clearing bank to be labelled money while deposits in the Post Office Savings Bank are not? I find it impossible, on the evidence of recent practice, to find any watertight reasons for so distinguishing. It is sometimes supposed that the distinction can be made to turn on the simplicity of the procedure for transferring the asset. When I take a coin or a note out of my pocket, and hand it across the counter, I am using money to make a payment. When I draw a cheque on a current

account at a bank, economists would certainly say that I am using money to make a payment. But if this act of writing an instruction to a bank is a use of money, why not also written instruction to the Post Office Savings Bank or a Building Society? And what could be more simple than the showing of a consumer's credit card? Nor is it altogether satisfactory to retreat to the fact that many Post Office and Building Society balances lie for long periods undisturbed, for this is also true of many balances in the Clearing Banks. Especially this is liable to be true of deposit account balances, yet most economists would regard them as money, equally with current account balances, and the procedure for paying them over to other people is scarcely less simple than drawing a cheque on a current account.

Nor is there conviction in the notion that the line can be drawn by reference to whether interest is earned. Present English practice is that interest is not paid on current accounts, but this has not always been so, nor does it universally apply in other countries where banking competition is more free. Even in present English conditions, large sums are held in current accounts as minimum balances, ordinarily undisturbed, as inducement to the banks to operate accounts without charge: interest is thus virtually paid and offset by turnover charges. Whether the question of what is money is made to turn upon what has been common usage among economists, or on whether the asset is commonly used as a medium of exchange, or on whether it yields interest, it is not possible to give an unambiguous answer.

A similar attempt to escape from the difficulties of identification of money is to be found in the distinction sometimes drawn between "active money" and "idle money." The actual division of bank deposits into demand deposits and time deposits is often thought of as a statistically convenient approximation to an economically significant division into active money and idle money. But this distinction is at best misleading. No asset is in action as a medium of exchange except in the very moment of being transferred from one ownership to another, in settlement of some transaction, and no class of asset used in this way can logically be excluded from the class of active money. Between transactions all money is idle. Yet if activity is held to cover the state of being held in readiness against possible use in exchange, then all monetary assets are active all the time. It is not merely that we cannot easily earmark for statistical assessment the quantity that is active: there is no such quantity, except in the all-embracing sense of all those goods or claims regarded by their owners as potentially useful for settling market commitments. It is this wide concept of liquid assets that we must put, in the place conventionally occupied by "the supply of money," as the monetary quantity influencing total effective demand for goods and services. And we must interpret it widely enough to include credit that can be brought into existence concurrently with a decision to exercise demand.

When all the assets included in this class are reviewed in detail we find that they include not only the deposit liabilities of banks but also the readily callable liabilities of a large and widening range of other financial intermediaries. The ease with which these intermediaries enlarge their balance-sheet totals is as relevant to the monetary situation as is the behaviour of those financial intermediaries we call " banks." Nor should we limit the range to firms ordinarily regarded as financial intermediaries. Among firms whose main activity is manufacturing or trading, most do a great deal of lending and borrowing: they extend " trade credit " to their customers, and they take " trade credit " from their suppliers. Many are active on both sides of the account, and nearly all are involved in credit transactions on one side or the other. The distinction between banks as creators of credit and other firms as users or intermediaries in the monetary field is if not completely false at least misleading. From the point of view of the pressure of effective demand, the crucial step is that which increases the power to acquire goods and services, on the part of people inclined to exercise it immediately; and banks are by no means the only firms to place this power in the hands of others.

That trade credit, in the sense of credit granted by firms whose primary business is non-financial, is an effective element in the supply of purchasing power, is a view sometimes conceded but with the odd qualification that it is only " net " credit that counts in this way. If, for example, a statistical measure is sought, it is supposed that only the excess of a firm's claims over its debts to others should be counted.[1] This is a position that cannot be sustained. We are thinking of the power to exercise demand for goods and services, and for this purpose the gross total of trade credit is relevant. An entire closed circle of firms in manufacturing industry may begin giving credit more freely, and all of them proceed to place large orders with each other; there is no doubt about the increase in effective demand, although the increase in credit granted by all the firms together is balanced by the increase in credit taken by all the firms together. No one would seriously suggest that bank credit should be " netted out " by deducting the debts people owe to the banks, although one of the tables in the Radcliffe Report curiously errs in this way.[2]

We should pause here to notice that a distinction between " credit " and " capital " is no more helpful in monetary analysis than is the distinction between banks and other creators of credit. This distinction between credit and capital was vigorously argued in the nineteenth-century literature of

[1] Cf. J. Viner, *Studies in the Theory of International Trade* (1937). In the course of his review of the writings of the Banking School and the Currency School, Viner says (p. 247) that " J. S. Mill went too far " in including trade credit in the stock of purchasing power. But Viner concedes the substantial point later in the same paragraph.

[2] Cmnd. 827 (1959), Table 22 (on p. 171). That in twelve months no one should, to my knowledge, have drawn attention to the oddity of column (1) in this table, is a sad commentary on the extent to which the arguments used in the Report have been understood.

the subject, and there are echoes of it in those contemporary views that draw a distinction between the "money market" (or "credit market") where the central bank has its business and, on the other hand, the "capital market," upon which the influence of the monetary authorities can only be indirect. It is better that we should think of a single market, or at least a single group of markets, in which immediate purchasing power is traded against claims whose variety, in maturity and in other respects, is infinite. In some countries this is a more imperfect, in others a less imperfect market; but the important likeness that links all parts of the market is the trading of more immediately for less immediately available purchasing power. All participants in the market are so trading; all are trading in capital in the sense of purchasing power, and none is trading in capital in the sense of goods. Each part of the market is as fundamentally a money market as any other, and each part of the market is just as much a capital market as any other. All are adding to the supply of credit when the claims against themselves are more immediately useful than the other claims which are the trading counterpart. This supply of credit, which can be immediately used for exercising demand, is no monopoly of the banks; the power of the banks to create credit (and it is credit, not money, that is relevant here) thus provides no justification for control of the banks while other credit agencies are left uncontrolled.

A presumption in favour of discriminatory control of the banks can, however, be established if it can be shown that there is a sufficiently firm proportionality between the volume of bank credit and the volume of other credit. If, when bank lending is curtailed, other lending must necessarily be curtailed in equal proportion, the control of banks becomes a useful technique, on the administrative principle that their heads are the easiest to hit. If every firm dealing in credit always held absolutely stable the proportionate distributions of its assets and its liabilities—that is to say, if balance sheets always had exactly the same structures—this proportionality of the supply of effective purchasing power to the supply of bank credit could be taken as the basis of policy. In fact, there are two important reasons why this strict proportionality cannot be assumed. The first is that in course of time people devise new financial intermediaries; the efficiency of the financial system increases, and this process tends to accelerate in a prolonged spell of business prosperity. The second—and in the short period relevant for most purposes of policy, this is the more weighty—the reliability of non-bank debtors varies according to the general trade prospect. This is, of course, our old friend "the inherent instability of credit"; but it is important to recognise that in its modern form it refers not so much to bank credit as to the relation between bank credit and non-bank credit. At a time when, as an anti-inflation measure, the authorities are enforcing a restriction of bank credit, the apparently favourable position of other debtors makes the extension of non-bank credit peculiarly easy, as

we saw in England in the middle 1950s.[1] The important practical question is how easily one source of credit can replace another, and whether such a disturbance sets up any corrective process which will act quickly enough to be useful for purposes of policy.

Before I turn to this fundamental question, I must refer to the use of another concept, deeply embedded in the literature of our subject. This is the velocity of circulation. I have hitherto been formulating monetary phenomena by referring to the supply of and the demand for various assets and liabilities; but many writers have thought it more convenient to refer to variations in demand as variations in the velocity of circulation of money. They think of people not as wanting more or less intensely to hold money but as being less or more quick to pass on money in exchange for goods and services. Put like this, the one concept is simply the reciprocal of the other, and it does not matter which we use. I myself prefer to think in terms of the demand for money balances, because the term " velocity of circulation " implies closer analogy with a physical process than I can find in the working of the monetary system, and I notice that when economists seek to explain changes in the velocity of circulation they at once begin to talk about the intensity of the demand for money. Like houses and other assets, money is not going round steadily all the time. Instead—again like houses and other assets—it is always resting in the ownership of one person or another, save for the isolated moments when it changes ownership. What people mean when they say that the velocity of circulation has increased is that the volume of transactions has increased relatively to the stock of money (in some sense), or that the national income has increased relatively to the stock of money (the ratio more specifically referred to as the " income velocity of circulation "). As a label for the purely statistical phenomenon of the ratio of one quantity to another, the term velocity of circulation is harmless enough, and so well established in the literature that it would be foolish to refuse the convenience of using it. The trouble begins when we jump to the conclusion that a rise in the ratio of payments to bank deposits means only that firms have decided to put their bank deposits to faster use, whereas much of what has happened is that firms have decided to give more credit and people have shifted some of their savings into the hands of more nimble intermediaries. The artificiality of the concept lies, in short, in its reliance on a distinct and identifiable category of money; and one danger in using it lies in its encouraging us to overlook the relevance, to the pressure of total demand, of sources of credit outside this defined category. A further danger is that the definition

[1] No comprehensive statistics of trade credit exist, even for joint-stock companies. For companies quoted on the Stock Exchange and engaged in manufacturing, building and distribution, however, some figures can be extracted from the investigations made by the National Institute of Economic and Social Research. For these companies, the balance sheets relating to late 1956 showed trade creditors £2,050 million, as compared with £444 million bank loans, and trade debtors £2,609 million, as compared with £649 million cash and bank balances. The swings in these figures for trade credit, from one year to another, also dwarf changes in the bank credit and bank balances employed by such companies (*v.* Radcliffe Report, Cmnd. 827, paras. 297–311).

normally used being either bank deposits or bank deposits plus notes, which (particularly the notes) come fully into action only late in productive processes, a rise in the velocity of circulation is a phenomenon that lags behind a rise in the disposition to spend. The existence of this lag should warn us against undue reliance on any corrective mechanism set up by "a rise in the velocity of circulation."

The basis of such a corrective mechanism is sometimes represented as the anchorage of the velocity of circulation in the peculiar demand for the medium of exchange. Our examination of the nature of money and of the demand for it has, however, warned us that there is no single asset or group of assets that uniquely possesses a uniform monetary quality that is totally absent from all other assets. Except for purely didactic purposes, it does not help to talk about a normal velocity of circulation any more than it helps to say (which is the same thing) that the elasticity of demand for money is unity. On the other hand, convenience in settling transactions is *an* important quality in a monetary asset; various monetary assets have this quality in varying degrees. If money income rises, or if the supply of some of these assets falls, people will feel some lack of this convenience in relation to the contingent needs against which they hold such assets, and this is the substance to which economists refer when they assume a certain normality in the velocity of circulation. But we must remember that many assets have the monetary quality in varying degrees; if, as the supply of some of them falls relatively to income or turnover, others can easily be increased, the sense of inconvenience is minimised, and we have to ask ourselves whether it remains effective enough to be interesting. We are in fact back at our major question of the relation between supplies of different classes of monetary assets, having merely reformulated, with the help of the concept of the velocity of circulation, the problems we had already traversed.

In our own time most attention has been given to a comparatively late link in the chain of argument: the question of how, as the supply of monetary assets becomes less adequate, increasing inconvenience manifest in rising interest rates provokes a fall in total demand. Although this part of the argument has always had some attention, the almost exclusive concentration upon it is something of a post-1920 novelty. In the great controversies of the nineteenth century the prior question of the relation between varied monetary assets was always well to the fore. In the early part of the nineteenth century one of the major questions related to the connection between the Bank of England's note issue and the issues of the country banks. Thornton, in his *Paper Credit* (1802), had developed the view that the issues by the country banks were substantially governed by the Bank of England's issue.[1] He may have been wrong in this opinion, but he certainly regarded it as important, because he regarded both kinds of notes as money, the supply of which was relevant to the price level. When the Bullion Committee (of

[1] H. Thornton, *An Enquiry into the Nature and Effects of the Paper Credit of Great Britain*, pp. 211–41.

which Thornton was a member) in 1810 investigated the depreciation of the pound they adopted this view in one of the more emphatic statements in their Report,[1] but only two pages later they carefully explained the power of country bank-notes permanently to displace Bank of England notes.[2] They also noted the importance of increasingly effective use of bank deposits in circumscribing the real demand for bank-notes. In the controversy which raged round the Report, and more especially in the controversies of the next three decades, the relation between country notes and Bank of England notes continued to be hotly debated. There were no indisputable statistics that could be used to help settle the argument, just as in our own day there are not yet statistics to enable us to convince each other on the question whether or not the liabilities of the clearing banks are absolutely crucial to the behaviour of the wider structure of credit.

In the next generation the most hotly debated question was the regulation of the issue of bank-notes. In this phase—the Currency School and Banking School controversy—those who argued for strict regulation of the issue of Bank of England notes were no longer prepared to rely upon any automatic dependence of country issues upon Bank of England issues. They argued for—and obtained—strict and direct limitation of the country issues. But this relation of country to London issues of notes now scarcely held the centre of the stage. The main dispute now raged round the position of other claims—bank deposits, bills of exchange and trade credit generally. The Currency School argued for strict regulation of the issue of bank-notes. The Banking School, more diffuse in their remedies for economic instability, were united only in their negative view that the Currency School remedy was invalidated by the fact that bank-notes formed neither the only nor the governing part of the supply of purchasing power. The use of bank deposits, bills of exchange and other forms of credit as substitutes for bank-notes had long been acknowledged in the literature; on the historical order of events as we know them, it might rather have been argued that bank-notes were a substitute for bills of exchange. But now that a strong case was being made for strict control of the supply of money, the question which was money and which was not money became of high practical importance; moreover, the spectacular growth of banking was emphasising the weight of bank deposits in the total circulation.

The simplest Currency School view was that only gold and notes were money, and that therefore the circulation of gold and notes together should be made to reflect the changes in the gold supply; this is the essence of the 1844 Bank Act. But this is doing the Currency School less than justice. Its protagonists did acknowledge the relevance of banking and other credit, but some took the line that while notes should be strictly controlled, deposit banking should be kept in order by some other measures; others

[1] In the opening of their Section IV.

[2] Cf. Thornton's Chapter IX, where qualifications are as abundant as in any modern survey.

argued that the velocity of circulation of banking and other instruments was comparatively so low that these were unimportant parts of the money supply; again others argued that, since gold or notes could be demanded in all final payments, the pressure of purchasing and economic activity could never for long get out of line with the supply of the basic monetary instruments. It was this last view that was destined to dominate many decades; it prevailed against the Banking School view that the components of the money supply were so many and varied, and such effective substitutes for each other, that any attempt to control their quantity was doomed to failure, and would probably aggravate economic crises.

The prevailing doctrine—which gave Britain its basic monetary laws for seventy years—depended on the fact that gold or Bank of England notes could be demanded in all final payments. This derived not merely from the law of 1833: it was deeply rooted in the country's practice for a long time before that. This singular quality of gold and notes became directly important as soon as a general breakdown of credit developed; at other times bank deposits and bills of exchange were generally good enough, but in a crisis a business-man had to be able to put his hands on notes or gold, or he risked bankruptcy. As long, therefore, as a financial crisis was thought a possibility, bankers and other granters of credit paid some regard, in the conduct of their lending business, to the state of the Bank of England's reserve. And just in these decades Bank Rate movements were beginning to be employed by the Bank of England as the method of protecting the Reserve. A rise in Bank Rate became all important as an index—a warning that a breakdown of credit, followed by a disastrous spell of depressed markets, might be just round the corner.[1] The Banking School were right in emphasising the variety and the importance of sources of credit, but the Currency School were right in arguing that the superstructure of credit could not for very long get out of line with the supply of the basic money, the gold and bank-notes. In this situation the broad line of argument developed in the first part of this paper was not important. But the economy was distressingly unstable.

It was also one in which some of the most relevant circumstances were changing. If it was right to assume that the superstructure of credit could not for very long get out of line with the supply of the basic money, experience very quickly showed that the possible time-lag could be of devastating importance. Partly because the Bank of England was not using its warning signal promptly enough, and partly because the underlying causes of instability were very strong, crises of the first order of magnitude recurred in 1847, 1857 and 1866. This experience led the authorities to modify the Currency School policy to the extent of admitting that the Bank of

[1] This interpretation of the *modus operandi* of Bank Rate at this time is convincingly argued by A. B. Cramp in his article, "Horsley Palmer on Bank Rate" (*Economica*, November 1959), and in his unpublished Ph.D. thesis (London), *Opinion on the Operation of Bank Rate, 1822–60*.

England must act as lender of last resort to prevent breakdown of the system. The crisis of 1866 was the last of the old kind, and Bagehot's writings ensured the respectability of the new policy. Nevertheless, Bank Rate continued to retain something of its power as a warning signal internally; this was partly because memories of the old-fashioned crises lingered on, and partly because, although it ceased to portend a breakdown of credit, a high Bank Rate was still apt to portend a spell of trade depression. Not until the effective adoption of Full Employment policies was the warning power of Bank Rate reduced to a ghost of its old self.

The scene was also changing in that the internal effects of Bank Rate were becoming relatively unimportant. In the second half of the nineteenth century London's power as an international financial centre grew fast, and the Bank of England was enabled to perform its duty of keeping the pound on gold by operating principally on the international capital position.[1] (This had always been an element in the *modus operandi* of Bank Rate, but in the period 1860–1914 it became the principal element.) Some of its direct influence as a signal for business-men remained, as I have suggested above; more importantly, the disturbance of the international capital situation disturbed investment in the developing countries overseas, with severe repercussions on the trade of the home country. Just how much monetary conditions really affected the trade cycle it is impossible to say; if we are looking only at the last few decades before 1914 I find myself much in sympathy with Rostow's view of " an essentially negative element," [2] for the rise in interest rates often waited until the boom was already cracking, and merely ensured that the depression should be severe. However, without going so far as this we must still admit that the quick power of Bank Rate on the international capital position was the dominant feature, and this change of emphasis was duly reflected in the dwindling literature on monetary questions. Bank Rate as the controller of international gold movements came to occupy a leading place in expositions of the monetary system; the Quantity Theory and the 1844 Act remained alongside the discussion of Bank Rate, but the old and the new were in this phase never really integrated. It was the literature of this phase that was more or less my introduction to the subject, and I well remember my first impression of confusion, whether a rise in Bank Rate increased the quantity of money (which seemed to be the result of attracting gold) or decreased the quantity of money (which seemed to be a necessary part of the deflation a rising Bank Rate was supposed to provoke). My teachers soon put this right, but when I look back at the pre-1920 literature I am not surprised at my early difficulties.

The main development of monetary thought in the course of the 1920s was the integration of these various elements into a single coherent body of

[1] For a contemporary exposition, see, *e.g.*, G. Clare, *A Money Market Primer* (2nd Edition, 1905), esp. pp. 103–7 (on effects on international movements) and 96 (for attitude that no disturbance of the internal economy is sought).

[2] W. W. Rostow, *British Economy of the Nineteenth Century*, p. 57.

theory. The development originated mainly, I believe, in the pre-1914 academic activity in the study of the trade cycle, though there was also powerful stimulus from the international monetary strains of the 'twenties themselves. Having regard to what we know Marshall to have been thinking at the turn of the century, it is not surprising that the reshaping of monetary thought in the next generation was largely the work of Marshall's successors, especially Lavington, Keynes and Robertson; and we must not forget that English economists were beginning to notice the work of Wicksell and his followers on the Continent.

As a survey of this kind must necessarily concertina many intricate episodes in the history of thought, I will summarise these developments of the 1920s simply by reference to the form in which they emerged, at the end of the decade, in Keynes's *Treatise on Money*. The *Treatise* has between its four covers many strands of thought, as those who were students in those days will remember too well; but for our present purpose we may confine our attention to two of them. The first is that the demand for money was refashioned by looking at money primarily as one among other stores of value, the preference for the peculiar convenience money possesses being weighed in the manner traditional in the ordinary theory of value, against the interest that could be obtained on the other stores of value. The second idea we must notice was, along Wicksellian lines, that the rate of interest influenced the balance between the demand for capital and the willingness to lend, thus providing a mechanism whereby the supply of money (and the demand for it) was linked with the pressure of total demand, and so with movements in the general level of prices.

The first of these developments—the liquidity preference theory of interest—represented a clean break from the Quantity Theory, in that money, ceasing to be a pure medium of exchange, ceased to have that freakish unit elasticity of demand and became something whose value was determined in a way we need not feel strange when we had just been learning a more universal Theory of Value.[1] But in his formulation Keynes preserved his links with tradition by notionally dividing money into "active money," whose elasticity of demand was unity, and "idle money," the utility of which behaved in the more ordinary way and had to be balanced against the interest that could be earned by holding bonds. For the purpose of establishing his main propositions Keynes need not have made this bow to his ancestors, but he did, and I suspect that life would be easier if we forgot about it; I have already noted the artificiality of the distinction. However, its use did facilitate demonstration of an equilibrating mechanism in the system. A rise in prices increased the amount of active money needed, the money available for idleness was thus reduced, the demand for bonds therefore fell, the rate of interest rose, demand for capital goods was checked

[1] Cf. J. R. Hicks, "A Suggestion for Simplifying the Theory of Money," *Economica*, February 1935, p. 3.

—and so the rise in prices was stopped. This is the Keynesian system of 1930 in baldest form, and the précis omits many sources of friction continually emphasised by Keynes. In terms of practical policy, the analysis did point advantage in control of the supply of money; to Keynes this meant control of the supply of bank deposits, and his attention to such subjects as the cash ratio in banks and central bank operations is always related to this. He emphasised throughout—and this is a big step beyond the Currency School position—that there is a dangerously long time-lag between movements in "bank-money" (*i.e.*, bank deposits) and the corresponding movement in notes, "so that a control over the volume of notes operates too late—after the evil has been done by a change in the volume of bank-money which may have taken place some months earlier."[1] He went further and, emphasising the crucial position of the rate of interest in the equilibrating mechanism, urged central bankers to think more directly in terms of forcing the rate of interest to behave in the required way.[2]

This was, of course, not the end of the Keynes story, and in the *General Theory* (1936) Keynes developed ideas that drastically modified any notion of the economic system as a self-stabilising system. Particularly, he argued certain consequences of the shortcomings of the rate of interest as part of the equilibrating mechanism: the liquidity trap and the notion of an underemployment equilibrium came in. Like the *Treatise* before it, the *General Theory* bristled with ideas, many of which were hotly disputed; but both in his 1930 emphasis on the rate of interest as a crucial cog in the mechanism and in his subsequent relative loss of faith in its efficacy Keynes had wide following. In such investigations as they were able to make the Radcliffe Committee found a good deal of support for the later Keynesian view. In this sense the scepticism of Radcliffe is Keynesian, but in certain other respects—and here I am thinking of parts of the *Treatise* that Keynes did not revise—the Radcliffe view of the economic system is quite unlike that of Keynes.

The break from the Keynesian exposition may perhaps best be seen by exaggerating it, imputing to Keynes a simplicity that was never his. Keynes was thoroughly traditional in drawing a sharp line between money and other assets. To him money had changed from being coin and notes to being notes and bank deposits, notes being the small change of "bank money." In his model there are four major classes of assets: cash, bank money, bonds and others; there are central banks (whose liabilities are cash), there are banks (whose liabilities are bank money and who are holders of cash and bonds as well as other assets) and there are non-banks (*i.e.*, corporations and individuals who are holders of cash, bank money, bonds and other assets, and who are also much concerned with spending on "real" assets). A distinction between money and bonds is that the

[1] Vol. II, p. 264.

[2] *Ibid.*, pp. 369–74; cf. Report of the Committee on Finance and Industry ("Macmillan Report"), Cmd. 3897, 1931, para. 359.

former is useful for payments and the latter are not; another distinction between them is that bonds do and money does not carry interest. With this classification and some reliance upon the interest rate as a balancer of savings and investment, we can make a coherent working model, useful for explaining how policy should be shaped.

But the world in which we live lacks these sharp distinctions. And, remembering that for purposes of policy we must get as close as we can to the points of business decision, the more we try to eliminate dangerous time-lags, the more blurred the distinctions become. There is no clear line between purchasing power that carries no interest and interest-earning assets that have no influence on purchasing power. "Commercial banks" shade into industrial banks, savings banks and building societies, and these into a host of other financial intermediaries; the liabilities of these are close substitutes for each other, so that a clamping down on one group will not create such an abrupt scarcity of liquidity as will have a worthwhile impact on the pressure of total demand. This is, of course, the kind of argument that was being used by the Banking School a hundred years ago, when J. S. Mill and others pointed out that the substitutability of bank deposits for notes was high, whence they argued that a control of notes alone would be merely a nuisance. Time's answer to the Banking School was the recognition that bank deposits were as good as notes, coupled with institutional arrangements for making good a Currency School contention that the supply of bank deposits was proportional to the supply of notes. Having got so far, we then got into the habit of saying that bank deposits were the important quantity, that our central banks should regulate the bank deposits and that notes could be left to take care of themselves.

Can we now, as a latter-day Currency School, argue that, although other financial claims are good substitutes for money, we can rely upon the constancy of their ratio to the bank deposits we have learned to control? I doubt it. Or can we now, following those who taught us all about central banking, force the non-bank lenders into a pattern by imposing on them liquidity rules analogous to those whereby the clearing banks are controlled? The Radcliffe Committee looked at the question, and shuddered. Or can we try to check the development of financial institutions, by proclaiming that none but the clearing banks may create money? This is not just an idle fancy: our ancestors did something like this when they strangled the country note issue—but they did not stop the private creation of money. They could not stop it, because money is the creation of the public that chooses to impute certain qualities to certain claims.

I have referred repeatedly to the Currency School and Banking School controversy because I believe that the arguments of the last few years have very close parallels with that earlier controversy. The Currency School case depended on sharp lines of distinction and rigid proportionalities. The case was accepted as the basis for practical policy; we muddled through

the next hundred years partly by modifying the policy, partly by imposing proportionalities and partly enduring disadvantages we no longer find tolerable. In modification of the policy, we developed central banking to dull the terror of financial crises, and now we have gone much farther by insisting that there shall be no trade depression. The age-old tendency of financial institutions to become more numerous, more varied and more efficient flourishes in an economy that avoids major breakdowns; the process is accelerated, and a policy that depends on a stable relationship between institutions become less and less realistic.

This is a negative conclusion, and it is because they took this view of the nature of money and the monetary processes that the Radcliffe Committee's conclusions appeared to give such little positive guidance. But even negative conclusions have their importance: we sometimes need to search around for something quite different which will get results. And the conclusions to which our general discussion points do, after all, have highly practical implications. To take a major point, restriction of the supply of bank deposits, if long continued, can be expected to become increasingly ineffective as a curb on total demand, because the demand for liquidity can be so well satisfied from other sources. Worse than this, restriction of the banks will increase the opportunities for alternative lenders, so that the banks will lose ground to their competitors and the heads the Government can hit will become progressively less influential in the behaviour of the economy. Or to take another point, on which the Radcliffe Committee's recommendation was grossly misrepresented in some quarters, consider the channels for local-authority borrowing. The fact that Treasury bills are, and local authority mortages are not, "liquid assets" to the clearing banks has some very short-period relevance, in that the banks are outstandingly efficient lenders, but if the market for credit is fundamentally a single market, an addition of short government paper has much the same effect on the monetary situation wherever it is injected. Banks are not the only lenders sensitive to liquidity.

Our analysis has its uses for bankers as well as for policy-makers. The English clearing banks, acting as a cartel, fix the rate they pay on time deposits, and have only one class of such deposits: at seven days' notice. They are sometimes urged to compete for deposits now going to building societies or hire-purchase finance houses by offering higher rates for longer periods. Against this proposal, it has been argued that the total of deposits in the clearing banks is fixed by the supply of "liquid assets," and that therefore the banks could get no more deposits by offering higher rates but would simply reduce their own profits. This over-simple argument can be made true only if we make certain assumptions about strictly rigid proportionality in the balance sheets of all sorts of firms and households, and insist that for one size of the national debt and one size of the national income there is only one possible size for the total of bank deposits. This

is a particular manifestation of the old idea that there is only one kind of money (in this case bank deposits) and that the demand for it is rigidly related to the national income. But once we admit that the liabilities of other institutions may be quite good substitutes for the liabilities of the clearing banks, and that business attracted by non-bank intermediaries affects the non-bank demand for national debt, the consequences of non-competition by the clearing banks become expensive to them. By refusing to compete, they stand to lose a larger and larger proportion of the total lending business in the country. To put the point in an extreme way, if the banks always ignored competition on the principle to which I have referred, their place as creators of the chief monetary assets would gradually be lost to other more aggressive financial intermediaries. And no doubt there would be quantity theorists a century hence to point out that the then predominant money (claims on the aggressive intermediaries) had increased roughly in proportion to the national income: they might even find that clearing bank deposits had become the small change of the monetary system!

Or are we perhaps already there? If the crucial decisions to place orders for production depend " upon the composition of the spender's assets and on his borrowing power and . . . upon the methods, moods and resources of financial institutions and other firms which are prepared (on terms) to finance other people's spending," [1] then in an important sense bank deposits have already become the small change of the system. This is no fad of a theorist's exposition, for its implications are surely lessons of the first importance to practical policy. For it means that there is no dependable monetary ceiling against which a boom will bump its head. As the boom rises, the sources of liquidity broaden, and the rising demand for the means of payment comes too late and is too easily satisfied. It follows that a policy of stabilising bank deposits and waiting for the expanding volume of payments to force interest rates upward, while intuitive central bankers try to be nimble in " following the market," is not enough; action would always be too late, as it was when strain on the note-issue was expected to set the corrective mechanism in motion. If monetary policy is to be used at all, we must make it operate on as broad a front as possible; action on the supply of bank money must be thought of as purely incidental to a positive, aggressive and far-reaching interest-rate policy. How far we can depend on this is, as the Radcliffe Committee emphasised,[2] a matter on which much more systematic investigation is required. If we want to catch up with events and accept the implications of the Full Employment policy we must urgently investigate the efficacy of a far more vigorous interest-rate policy than any we have yet seen, and, lest this should (as I expect) prove a non-starter, we must think again on how the flexibility of fiscal policy might be increased.

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[1] Radcliffe Report (Cmnd. 827), para. 389. [2] *Ibid.*, para. 474.

# DISTRIBUTION AND PRODUCTIVITY UNDER INFLATION, 1947–57 [1]

1.0. The main object of this paper is to see whether, on an international survey, the rapid rise of national money incomes in recent years has been associated systematically with any changes in distribution. The usefulness of the inquiry derives from the number of countries surveyed, rather than from analysis of the statistics country by country. The common categories in which these statistics are presented may conceal some substantial differences. But we are in the presence of a very general and far-reaching movement of money incomes and prices, and if such a movement has any predominant effect on the relative size of pay and property incomes in contemporary economies generally, or in those of a certain type, the present evidence could hardly fail to show it; and similarly, if there is no such effect.

1.1. We have in fact attempted two surveys. The first uses the materials gathered in the *United Nations Yearbook of National Accounts Statistics* to follow the distribution of the net domestic product between three sectors—pay of all kinds; incomes of unincorporated enterprises; and the remainder, treated as property income—year by year, mostly from 1950 to 1957, in some twenty-five countries. The criterion of inclusion has been simply the availability of the accounts in the three-sector form: some important economies—such as, in Europe alone, Denmark and Norway, Italy and West Germany—have had to be omitted, and those included comprise some that are small and some in whose statistics the range of estimate can hardly be other than wide. The second survey takes eight countries for which the nationally reported statistics enable us to trace the movements not only of income but also of the deployment of the occupied population, and which include some of the major industrial economies, and some of the major exporters of primary products: they are Australia, France, the Netherlands, New Zealand, Sweden, the United Kingdom, the United States and West Germany. Here we have used the estimates of the numbers occupied to adjust the shifts of income between sectors for the associated shifts in the number of income-recipients, and so to follow the relative movements of average pay per employee and the average product available per head of the whole occupied population, including employers and self-employed.

[1] We are very much indebted to Dr. H. van Blankenstein, of the Royal Netherlands Embassy in London, for most helpful provision of statistical materials; and to J. C. R. Dow, W. M. Gorman, P. E. Hart, R. G. Lipsey and A. W. H. Phillips, for their discussion of a draft of this paper, with suggestions for further inquiry which have added much to the interest of the materials now presented. But none of these is responsible for any statement of fact or opinion in the present paper. We are further indebted to Miss Sheila Chantler for drawing the figures.

1.2. As a by-product of our inquiry, we offer some materials concerning the course of inflation before and after the check to the rise in wholesale prices that came about in 1951–52, and the possible connections between the rate of rise of prices and the growth of productivity.

2.0. The survey based on the *U.N. Yearbook of National Accounts Statistics* is presented in Figs. 1, 2 and 3, and in Tables V and VI of the Appendix.

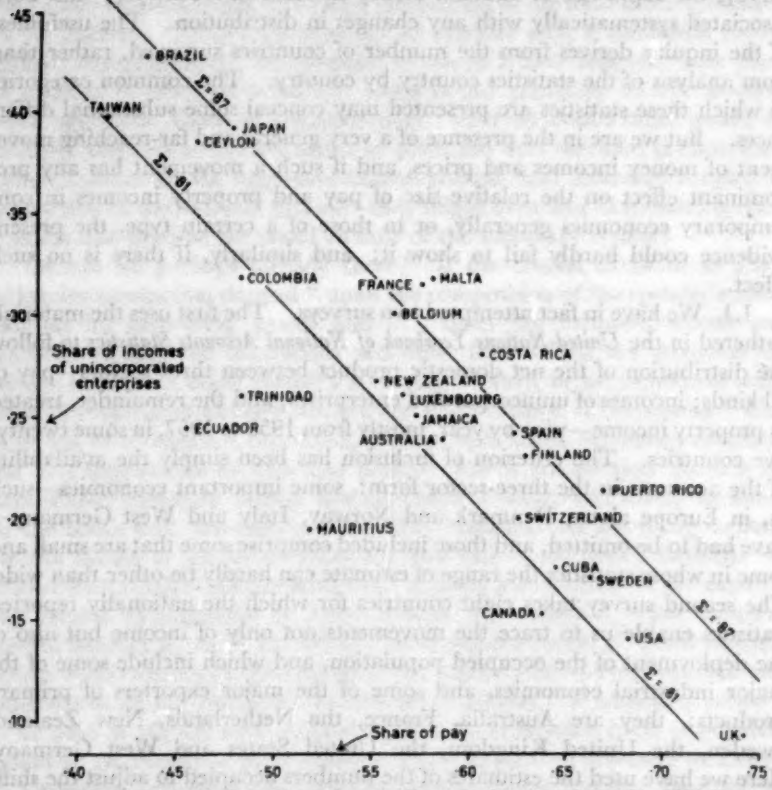



FIG. 1.—Shares in net domestic product, medians of values recorded within 1950–57.

Before discussing the outcome we must set out some points in the treatment. (*a*) Here, as elsewhere, we have not tried to distinguish wages and salaries, but have included all sorts of compensation of employees under the one head of pay. In the past it is the share of wages alone that has had most attention. But salaries are now bigger in the aggregate relatively to wages than they used to be; and the line between the two no longer follows a well-marked social boundary—there were always some occupations through which it could be drawn only arbitrarily, and as the occupational structure changes

in an era of great technical advances, the sectors of the labour market where it still serves to mark off non-competing groups become a smaller part of the whole. (*b*) As far as possible we have deducted net income from abroad from national income, so as to reach an estimate of net domestic product, and we have assumed throughout that any such deduction should be made wholly from reported property incomes, though this assumption is not warranted for remittances from emigrants. In some countries no estimate of net income from abroad was given, and we made no adjustment. (*c*) The incomes of unincorporated enterprises—that is, broadly, of the self-employed—proved to play a vital part in the comparison of different countries, and so we had to leave out those countries which did not report such incomes separately from profits and other property income.

2.1. Our main concern is with movements from year to year, but the comparison that the present data permit between the distributive patterns of different countries in the same period presents one striking feature which we must pause to notice at the outset. At a first glance the share of pay in the net domestic product is seen to vary widely from one country to another —in not a few countries it is less than a half, in the United Kingdom and the United States it is 70% and more. But when we bring into account the share of the self-employed we find much levelling up. If we take for each country the median of the annual values of the combined shares of employees and the self-employed, we find that sixteen out of the twenty-five countries lie between 81 and 87%. The scatter is shown in Fig. 1. The question arises how far this combination is significant. The self-employed are made up mainly of the professional man, the small trader and shopkeeper, the craftsman doing bespoke or repair work, and the small farmer; where the sector is large it is the trader and farmer who predominate. Probably the part of the income of the self-employed that is a return on property is small.[1] The earned part, however, is non-contractual, and for the farmer it fluctuates with the price of the produce. It seems, therefore, on the whole, that if we want to compare the return to labour as a whole in different countries at any one time we do well to take the incomes of employed and self-employed together, and treat their sum as an approximation, but that when we compare one year with another in any one country we must bear in mind that the incomes of the self-employed are liable to sharp changes from causes which bear only indirectly on the pay of employees in the same country.

2.1.1. In assessing the significance of the similarity between the composite share of work in different countries we must allow that if this share

[1] We have tried the effect of assuming that the incomes of the self-employed in each country are properly divisible between pay and property incomes in the same proportions as the remaining income of the country is so divided; these proportions are given in row 4 of Table V. But the assumption is itself questionable, and the scatter it yields does not seem significantly different from that of Fig. 1, though of course the combined share of work runs lower.

is in fact generally not less than three-quarters, the proportionate differences in it between one country and another are inherently contained within a comparatively small range. The variability appears wider if we look at

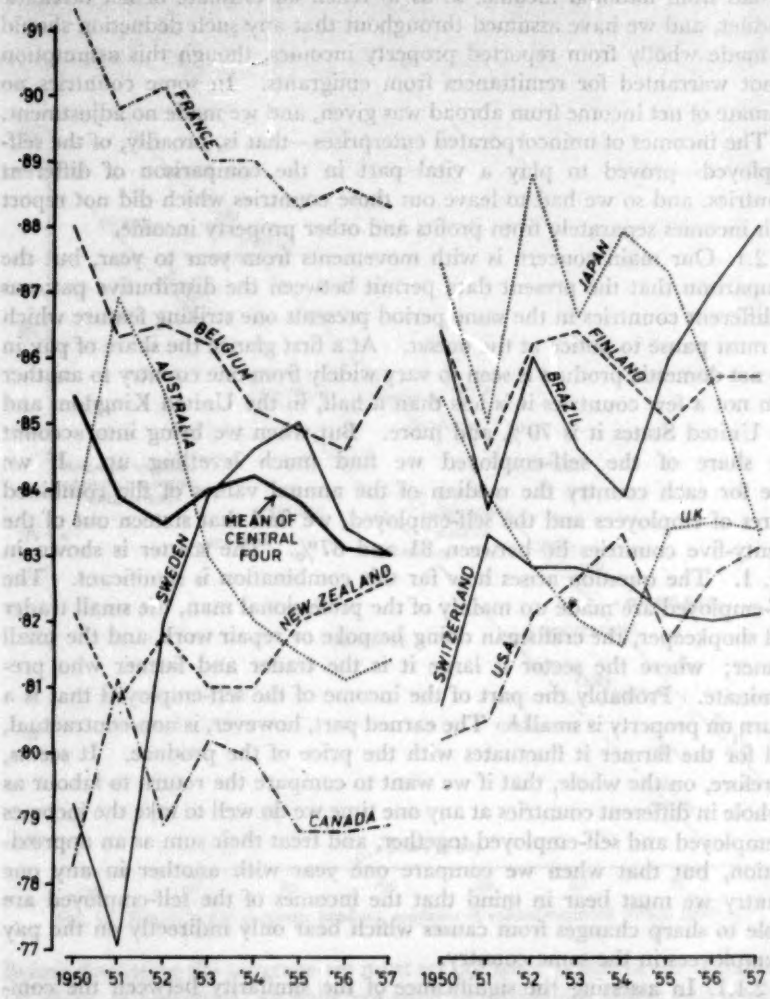



FIG. 2.—Pay of employees plus incomes of unincorporated enterprises as share of net domestic product, 1950–57.

property income: though the range from 81 to 87% amounts to only about ±4% about the midpoint, it implies a range of from 19 to 13% in the share of property, and that is more than ±18%.

2.1.2. None the less, that the composite share of work should lie in the

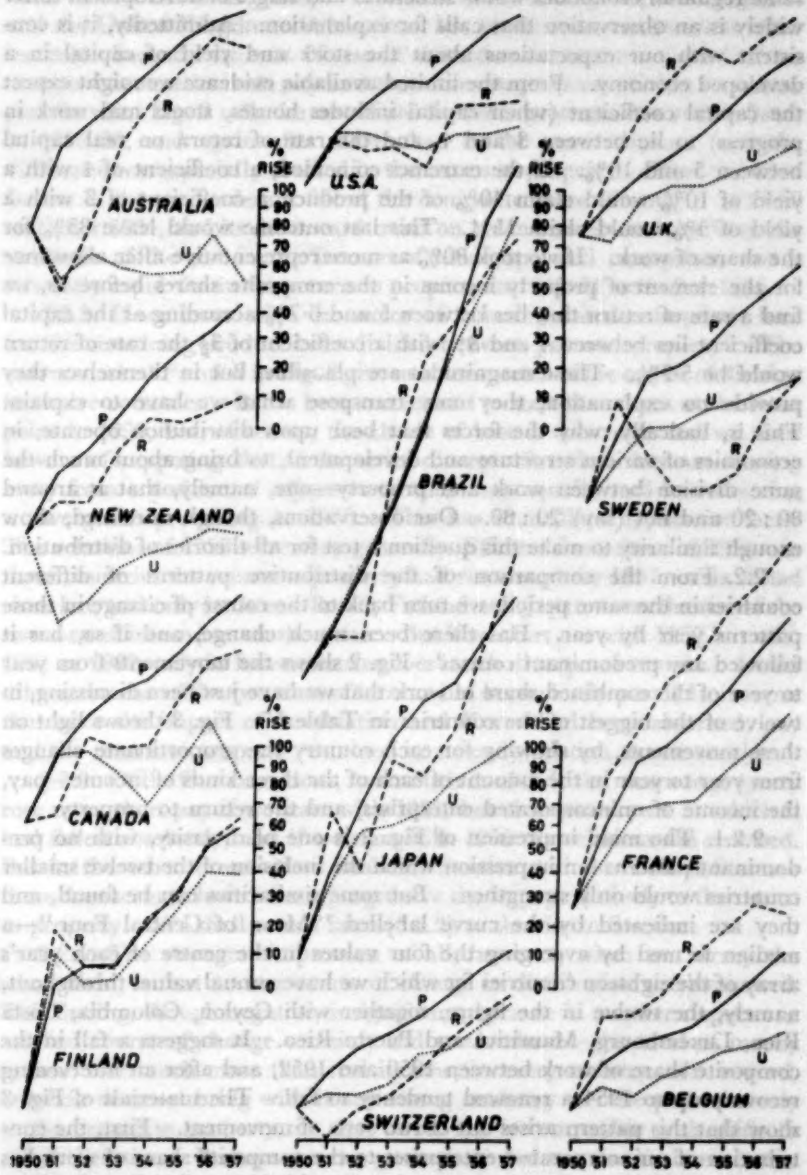



FIG. 3.—Proportionate changes in amounts of pay (P), income of unincorporated enterprises (U) and rest of net domestic product (R), 1950–57.

same region in economies whose structures and stages of development differ widely is an observation that calls for explanation. Admittedly, it is consistent with our expectations about the stock and yield of capital in a developed economy. From the limited available evidence we might expect the capital coefficient (when capital includes houses, stocks and work in progress) to lie between 3 and 4, and the rate of return on real capital between 5 and 10%. If the extremes coincided, a coefficient of 4 with a yield of 10% would claim 40% of the product, a coefficient of 3 with a yield of 5% would claim 15%. This last outcome would leave 85% for the share of work. If we took 80% as more representative after allowance for the element of property income in the composite shares before us, we find a rate of return that lies between 5 and 6·7% according as the capital coefficient lies between 4 and 3; with a coefficient of $3\frac{1}{2}$ the rate of return would be 5·7%. These magnitudes are plausible, but in themselves they provide no explanation, they only transpose what we have to explain. This is, basically, why the forces that bear upon distribution operate, in economies of various structure and development, to bring about much the same division between work and property—one, namely, that is around 80 : 20 and not (say) 20 : 80. Our observations, though unrefined, show enough similarity to make this question a test for all theories of distribution.

2.2. From the comparison of the distributive patterns of different countries in the same period, we turn back to the course of change in those patterns year by year. Has there been much change, and if so, has it followed any predominant course? Fig. 2 shows the movements from year to year of the combined share of work that we have just been discussing, in twelve of the biggest of the countries in Table V. Fig. 3 throws light on these movements, by showing for each country the proportionate changes from year to year in the amount of each of the three kinds of income—pay, the income of unincorporated enterprises, and the return to property.

2.2.1. The main impression of Fig. 2 is one of diversity, with no predominant pattern: an impression which the inclusion of the twelve smaller countries would only strengthen. But some similarities can be found, and they are indicated by the curve labelled "Mean of Central Four"—a median formed by averaging the four values in the centre of each year's array of the eighteen countries for which we have annual values throughout, namely, the twelve in the figure, together with Ceylon, Colombia, Costa Rica, Luxembourg, Mauritius and Puerto Rico. It suggests a fall in the composite share of work between 1950 and 1952, and after an intervening recovery up to 1954 a renewed tendency to fall. The materials of Fig. 3 show that this pattern arises out of two sorts of movement. First, the contribution of unincorporated enterprises to the composite share of work has very greatly fallen. In some countries—notably Australia, Canada, New Zealand and the United States—the aggregate income of unincorporated enterprises has on balance hardly changed during eight years in which

other income has risen greatly. In others—such as Belgium, France, Japan and the United Kingdom—it has risen, but by no means as much as other income. Second, the rate of rise of this other income has varied: in a number of countries both pay and the return to property (if that term may pass for what Fig. 3 calls the rest of net domestic product) rose rather faster in 1950–52, and again after 1954, than in the years between, and the difference was especially marked in the return to property. Thus the main factors in the preponderant fall of the composite share of work in 1950–52 and after 1954, and its downward trend on balance, seem to have been the smallness of the rise in the income of unincorporated enterprises, and a relatively rapid rise in the return to property in 1950–52 and after 1954.

2.2.2. If we leave aside the sector of unincorporated enterprises, how has the remaining product been divided between pay and property? The curves marked *P* and *R* in Fig. 3 give us a conspectus of the course of division in twelve countries. It has been convenient to start the curves at the same point in 1950, but, of course, the choice of base is arbitrary, and we must beware of supposing that if the series diverge after that they are moving away from a position of adjustment: they may equally well be correcting a divergence prevailing in 1950. This has immediate application here. The relations of 1957 were very generally different from those of 1950: in three countries the return to property had risen more by 1957, in six it had risen less, and only in three—Brazil, Finland and Japan—was the rise of the two sorts of income much the same. But if we start not with 1950 but with 1951 or 1952, only in four countries does much divergence remain. In the others, the rise of the two sorts of income has been closely parallel: it seems that once the impact of devaluation and Korea had been absorbed, pay and the return to property remained in a steady relation to one another.

2.2.3. Of the four exceptions, Australia is doubtful: the return to property rose more than pay if we start with 1951, but that was a year in which it had fallen absolutely, and if we start with 1950 the relations are reversed. But in the other three—New Zealand, Sweden and the United States—there does seem to have been a progressive rise in pay relatively to the return to property. We shall return later (3.3.5) to the rise in Sweden.

2.2.4. The strongest impression of all, however, when we survey the whole field, is that no one course of change in distribution predominated. This finding, though negative, is significant, because in another respect one marked course of change certainly did predominate—the total of money income rose much more than real income, in every country. In a word, inflation does not bring with it any strong tendency to raise pay relatively to the return to property, or vice versa, but is compatible with shifts in either direction. Perhaps we can go farther, and surmise that resistances to inflation, which hold back prices or money incomes in some sectors of the economy, tend to bring distributive shifts, but that where inflation is least impeded and most general its distributive effects (between those broad

categories alone that we are considering here) are least: it may be more than a coincidence that in Fig. 3 the *P* and *R* curves keep closest together in the three countries where their rise is steepest—Brazil, Japan and Finland. But Table I also shows that elsewhere the shifts were still not very big, nor were they systematically connected in size or direction with the rate of rise of money income.

TABLE I

| Country. | Rise in net domestic product in terms of current money, 1957 on 1950. | Change, 1957 on 1950, in: Combined share of pay and unincorporated enterprise in whole net domestic product. | | Share of pay in net domestic product outside sector of unincorporated enterprise. | |
|---|---|---|---|---|---|
| | % | (No. of percentage points.) | | | |
| Brazil | 305 | +2 | | +4 | |
| Japan | 145 | | −4 | | −2 |
| Finland | 117 | Nil | | Nil | |
| France | 115 | | −3 | | −3 |
| Colombia | 110 | +1 | | Nil | |
| Sweden | 77 | +4 | | +6 | |
| Luxembourg | 76 | | −6 | | −7 |
| Canada | 69 | +1 | | +1 | |
| United Kingdom | 69 | | −2 | | −1 |
| Costa Rica | 65 | | −1 | | −2 |
| Mauritius | 57 | | −5 | | −5 |
| Puerto Rico | 53 | Nil | | +1 | |
| New Zealand | 52 | +1 | | +5 | |
| United States | 51 | +3 | | +4 | |
| Australia | 51 | | −3 | +2 | |
| Switzerland | 50 | +1 | | +2 | |
| Belgium | 49 | | −2 | | −2 |
| Ceylon | 35 | | −4 | | −6 |

3.0. So far we have been considering the aggregate amounts of income accruing to three sectors, in some twenty-five countries for which estimates have been made available through the United Nations in comparable form. We shall now examine eight countries more closely, bringing in particulars of the deployment of the occupied population, and using as our indication of distributive tendencies the pay/income ratio. This is the ratio which the average pay per employee (taking wages and salaries, and employees of every grade, together) bears to the average income available per head of the whole occupied population.

3.1.1. The pay/income ratio is convenient on two grounds. First, it takes account of the dependence of the division of the product between different sectors on the deployment of the occupied population between them. The share of pay in the product, for example, approaches 75% in the United Kingdom but is below 60% in France, mainly because employees in receipt of pay make up 92% or more of the occupied population of the United Kingdom, but only some 75% of that of France. The deployment

of the occupied population does not only differ widely between countries but may also change substantially from one time to another within one country: in recent years, for example, the proportion in the sector of unincorporated enterprise has generally been falling. We make an adjustment for these underlying differences when we follow not aggregate income but income per head.

3.1.2. The pay/income ratio is also convenient because it provides a first answer to the question, has pay kept pace with productivity? At any one time it shows what part of the product achieved per head of the occupied population goes to the average employee, and from one year to another it shows whether the employee has gone forward in step with the whole community, or slower or faster than the rest. Moreover, since changes in the amount of capital per head of the population are bound to be small within a short span of years even when investment runs high, its movements suggest whether the rate of return per unit of capital has risen or fallen from year to year.

3.1.3. But it has its drawbacks. One is that though it does not depend so directly as the share of pay as a whole on the size of the sector of unincorporated enterprise, that is, of self-employment, it is still influenced by that sector. If the employees of an economy are working alongside poor peasant proprietors, their own pay will bear a higher ratio to the average income of all occupied persons than if the self-employed were prosperous professional men. If there were no self-employed at all, and all "employers" were managers and so employees, the pay/income ratio would be the same as the share of pay in national income.[1] When we bring in the self-employed, they make the pay/income ratio higher or lower than the share of pay, according as their average income is smaller or bigger than average pay.[2] This must be remembered when the ratio is used for international comparisons.

[1] $$\text{Share of pay in national income} = \frac{\text{Average rate of pay}}{\text{Average income per occupied person}} \times \frac{\text{No. of employees}}{\text{No. of occupied persons}}$$
$$= \text{Pay/income ratio} \times \text{Proportion of employees in all occupied}$$
It will be remembered that "average income per occupied person" here is the quotient of the whole national income divided by the number of occupied persons, and not the average of the incomes accruing to occupied persons alone.

[2] Suppose there are $E$ employees, with average pay $p$, and $S$ self-employed, with average income $t$. Then if as before we neglect the element of return to property in the incomes of the self-employed we can approximate the aggregate return to work by $Ep + St$. Let this be a proportion $\lambda$ of the national income $Y$. Then the pay/income ratio is defined as

$$p \div \frac{Y}{E+S}$$
$$= p \div \frac{Ep+St}{\lambda(E+S)}$$
$$= \lambda \div \frac{Ep+St}{Ep+Sp}$$

With a given division of national income between work and property, the pay/income ratio will be lower according as the average income of the self-employed is greater than average pay, and this influence will be stronger, the greater the relative numbers of the self-employed.

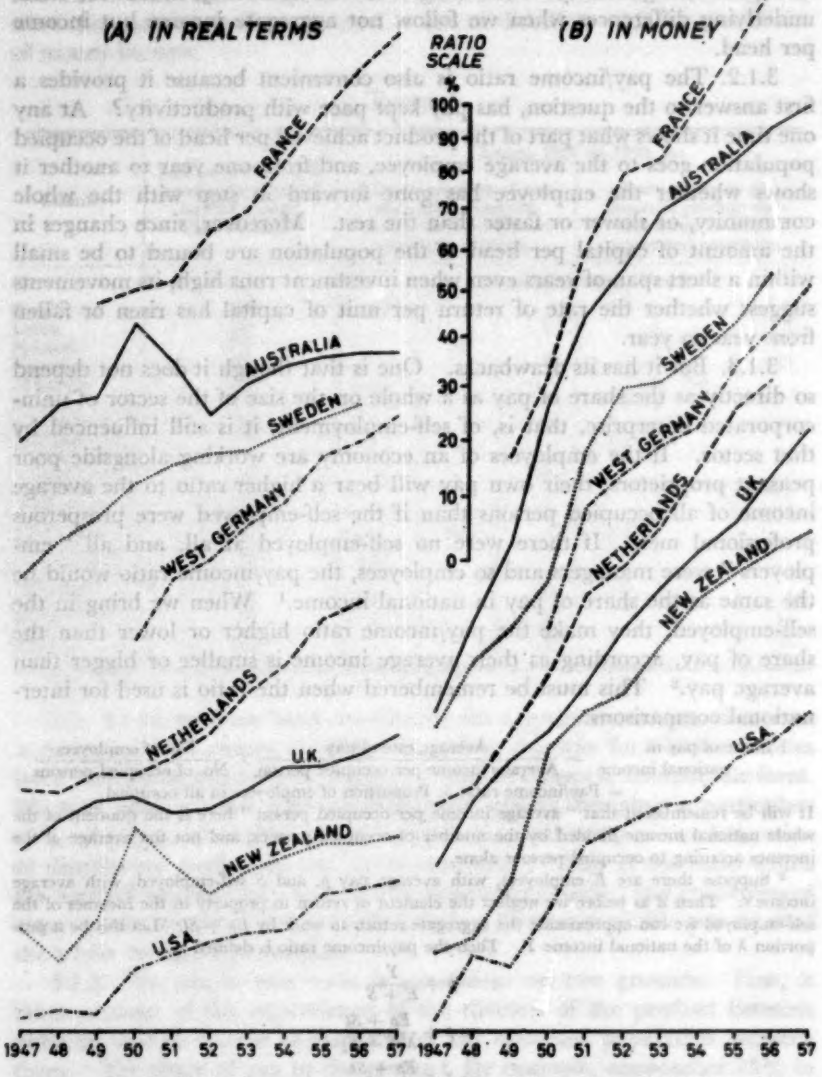



FIG. 4.—Rates of rise of income per head of occupied population, 1947–57.

3.1.4. The pay/income ratio also has this drawback, that we cannot proceed directly from ratios calculated for different sectors to the ratio for the whole economy: later we shall give ratios estimated separately for the agricultural sector and the rest of the economy, and these sector ratios can both be lower (or higher) than the ratio for the economy as a whole.[1]

3.2. We have calculated pay/income ratios for eight countries which provide sufficient particulars of their occupied population year by year, and which include examples of different types of economy: four continental European countries—France, the Netherlands, Western Germany and Sweden; the United Kingdom; the United States; and two countries largely dependent on the export of primary products, Australia and New Zealand. A broad survey of the movements of real and money income per head of their occupied populations since 1947 is provided by Fig. 4; the data are in Table VI. We obtained the series for real income by deflating money income per head with a general price index, made by combining the series available in each country for cost of living, wholesale prices and rates of pay, in the proportions 8, 1, 1. It will be seen that all eight countries have achieved a substantial rise in real income per head, but in all of them the rise in money income per head has been much greater.

3.3.1. In this setting we can look at the pay/income ratios. The data are again in Table VI, and Fig. 5 shows the ratios for the agricultural sector and the rest of each economy separately. The reason for separating the agricultural sector is that it takes the impact of swings in the prices of primary products in world markets; especially during and after the Korean

[1] The proportions of the following example are not very different from those of Sweden:

| | Sectors. | | |
|---|---|---|---|
| | Agricultural. | Rest. | Whole economy. |
| (*a*) Income | 3 | 27 | 30 |
| (*b*) Pay | 1 | 18 | 19 |
| (*c*) No. of occupied | 6 | 27 | 33 |
| (*d*) No. of employees | 3 | 24 | 27 |

Pay/income ratio $= \frac{(b)}{(d)} \div \frac{(a)}{(c)}$

For the agricultural sector, this $= \frac{1}{3} \div \frac{3}{6} = 66{\cdot}6\%$

For the rest, this $= \frac{18}{24} \div \frac{27}{27} = 75{\cdot}0\%$

For the whole economy, this $= \frac{19}{27} \div \frac{30}{33} = 77{\cdot}4\%$

If in the rest the figures for pay and the number of employees instead of being 18, 24 were 3, 4, the pay/income ratio in each sector would be unchanged, but that for the whole economy would be only about 63%.

In general, if the quotient $(b) \div (d)$ is now higher in one sector than another, and the absolute values of $(b)$ and $(d)$ in that sector are raised in the same proportion, the quotient for the whole economy will be raised, and the pay/income ratio there will rise with it, though there will have been no change in the pay/income ratios in the sectors. The pay/income ratio in the whole economy will likewise be raised if the absolute values of $(a)$ and $(c)$ are raised in the sector where their quotient is lower.

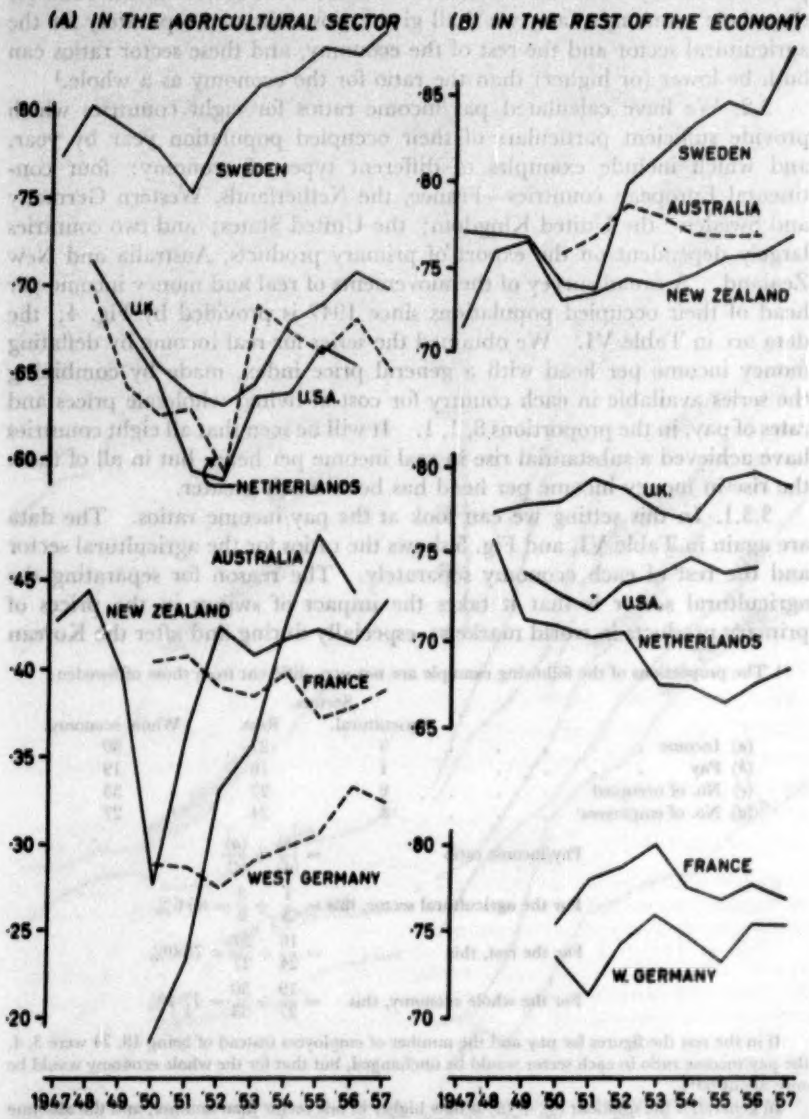



FIG. 5.—Pay/income ratios.

War these were wide, and in some economies they brought a big but soon reversed change in the relative size of profits and of incomes of unincorporated enterprises. We therefore thought that in separating the agricultural sector we should be largely removing an exogenous disturbance of the usual processes of distribution within the economy, which could be seen more clearly in the remaining sector. But the data for the whole economy are given in Table VII, though not graphed.

3.3.2. We must not place too much weight on the results we get for the internal proportions of the agricultural sector by itself: there is too much dubiety about the number of employees within the labour force of agriculture, and about their effective rates of pay, including payments in kind. The differences between the general levels of the pay/income ratio in different countries are therefore hardly capable of any direct interpretation. But the pattern that appears in the year-to-year movements in a number of countries, of a fall in the ratio down to 1952 and then a rise, is significant, and can be attributed to the opposite movement of the prices of primary products; though something may also be due to an increasing tendency, through public agencies for wage-fixing and through the pull of job opportunities in the towns, to bring up the wages of the farm worker nearer to those of the worker in industry.

3.3.3. In the other sector, that is, in the whole economy save agriculture, forestry and fishing, we see at once that the ratios of the different countries are at very much the same level. Sweden rises away from it in the later years, the Netherlands fall below it; but the other six are all never far from 0·75. This level, moreover, they keep. There are movements up and down, especially in the earlier years in New Zealand and (as the ratio for the whole economy shows) Australia, where we may see the impact of wide movements in the prices of exports. But elsewhere the movements lie within limits only about 4 percentage points apart, and they show no trend. We can, therefore, say that for most of the time in these six countries (outside agriculture) the average pay of an employee has been very closely three-quarters of the product available per head of the occupied population, and that this relation has been kept at a time when pay and profits have been bounding up year after year and the national income in money has as much as doubled in a decade.

3.3.4. The similarity of the ratios in different countries is another facet of the common pattern of distribution already illustrated in Fig. 1, and it raises again the question why the numerical outcome of the process of distribution should be so nearly the same in different countries. But no less striking is the comparative stability of the ratio within each country. Evidently there is some mechanism that keeps the returns to work and property in a fairly settled relation to one another even when their absolute amounts are changing rapidly under various pressures, some of them very different from the impersonal forces of the competitive market. It may be

that profits have been rising under the pull of demand, and pay has risen only consequently; or it may have been the claims for higher pay that were pushed through in the first place, with only consequent rises in prices and absolute profit margins; or something of both processes together, with this one or that taking the lead from one time to another. On this our materials throw no light. But they do show that whatever processes are actually at work are such as to bring about an outcome which remains remarkably the same. There is a paradox to resolve here. The quickness of the adjustment by quite large amounts implies, we might say, some freedom of the parties to name their own price; and yet when they have named it we find that an invisible hand has actually been holding them on a short rein.

3.3.5. But in the Netherlands and Sweden the rein seems not to have been so short: here the pay/income ratio outside agriculture has shifted progressively, over some five or six years, in the one country downwards, in the other upwards. If in the Netherlands we divide the whole national income into two components only, pay and the rest, we find that pay has risen fairly steadily by as much as nearly 10% a year, but the rest rose more than that from 1947 to 1948, and continued to rise somewhat faster until 1955; in the last two years its increase has been checked. There is no presumption that the proportions obtaining in 1947–48, at an early stage of recovery, should have persisted; but by the departure from them the pay/income ratio outside agriculture was brought to a lower level than we find elsewhere in Fig. 5. The major change seems to have been a rise in undistributed profits.[1] In Sweden the origin of the shift is more sharply defined: whereas pay rose year by year, by rather more than 9% a year on the average, the rest of national income actually declined for two years after 1951, and only in 1957 did it regain and pass the level of that year. The main source of this contraction and slow succeeding growth lay in undistributed profits, which after a sharp rise in 1950–51 fell back until in 1955 they were smaller than they had been seven years before.[2] Thus in both countries the main explanation of the shift of the pay/income ratio lies in a divergent movement of undistributed profits, but in the Netherlands they rose, in Sweden they fell.

4.0. Our materials enable us to throw some light on the course of inflation in the eight countries, and to ask whether any connection can be traced between the rates of rise of prices and of productivity.

4.1.1. We can form an indication of the course of the general level of labour costs per unit of output, by dividing the index of real product per head of the occupied population (already shown in Fig. 4) into that for

[1] Centraal Bureau voor de Statistiek, *Statistische en econometrische onderzoekingen*, 3e. kw. 1959, p. 111.

[2] *Nationalbokföring för Sverige, 1938/39, 1946–1957* (Meddelanden från Konjunkturinstitutet, Serie B.27, 1958). Table 11, I.22, Disposable, and VI.4, Savings by Enterprises (including the irregular part of the residual).

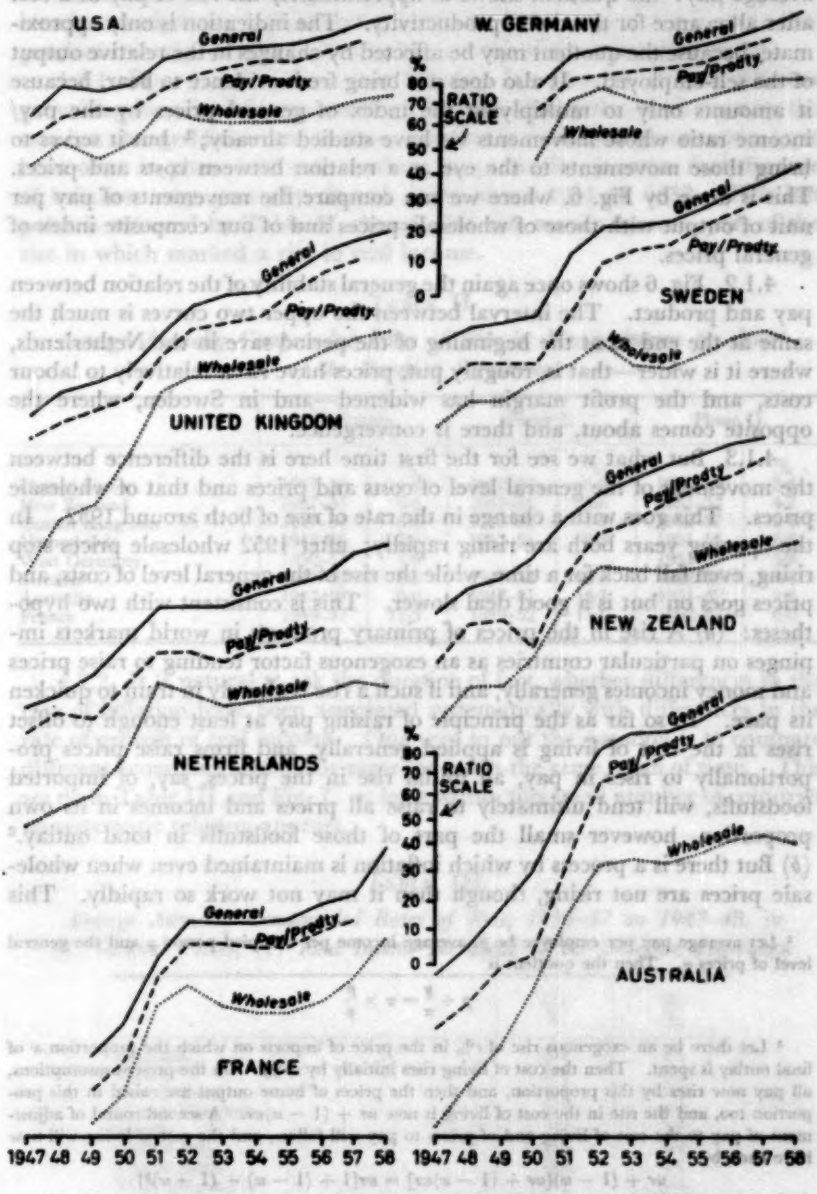



FIG. 6.—Indexes of general and wholesale prices and of pay per unit of output.

average pay: the quotient shows us approximately the rise of pay as a cost after allowance for the rise of productivity. The indication is only approximate, because the quotient may be affected by changes in the relative output of the self-employed. It also does not bring fresh evidence to bear, because it amounts only to multiplying the index of general prices by the pay/income ratio whose movements we have studied already; [1] but it serves to bring those movements to the eye as a relation between costs and prices. This is done by Fig. 6, where we can compare the movements of pay per unit of output with those of wholesale prices and of our composite index of general prices.

4.1.2. Fig. 6 shows once again the general stability of the relation between pay and product. The interval between the upper two curves is much the same at the end as at the beginning of the period save in the Netherlands, where it is wider—that is, roughly put, prices have risen relatively to labour costs, and the profit margin has widened—and in Sweden, where the opposite comes about, and there is convergence.

4.1.3. But what we see for the first time here is the difference between the movement of the general level of costs and prices and that of wholesale prices. This goes with a change in the rate of rise of both around 1952. In the opening years both are rising rapidly; after 1952 wholesale prices stop rising, even fall back for a time, while the rise of the general level of costs, and prices goes on but is a good deal slower. This is consistent with two hypotheses: (*a*) A rise in the prices of primary products in world markets impinges on particular countries as an exogenous factor tending to raise prices and money incomes generally, and if such a rise is already in train to quicken its pace. In so far as the principle of raising pay at least enough to offset rises in the cost of living is applied generally, and firms raise prices proportionally to rises in pay, an initial rise in the prices, say, of imported foodstuffs, will tend ultimately to raise all prices and incomes in its own proportion, however small the part of those foodstuffs in total outlay.[2] (*b*) But there is a process by which inflation is maintained even when wholesale prices are not rising, though then it may not work so rapidly. This

[1] Let average pay per employee be $p$, average income per occupied person $y$ and the general level of prices $\pi$. Then the quotient is

$$p \div \frac{y}{\pi} = \pi \times \frac{p}{y}$$

[2] Let there be an exogenous rise of $r$% in the price of imports on which the proportion $w$ of final outlay is spent. Then the cost of living rises initially by $wr$%. On the present assumptions, all pay now rises by this proportion, and then the prices of home output are raised in this proportion too, and the rise in the cost of living is now $wr + (1 - w)wr$. A second round of adjustment of pay to the cost of living and of prices to pay will follow, and the cost of living will now have risen by

$$wr + (1 - w)[wr + (1 - w)wr] = wr[1 + (1 - w) + (1 - w)^2]$$

And so on, to the limit

$$wr\left[\frac{1}{1 - (1 - w)}\right] = r$$

mechanism keeps the margin between labour costs and prices remarkably steady, whether the impulse point by point comes from a rise in the value product or a rise in costs. It may be at work at the same time as (*a*).

4.2.1. Figs. 4 and 6 show that inflation has gone on at very different prevailing rates in different countries, but also that within each country the rate has changed from time to time, and that in such changes countries have been often in phase with one another; in particular, it seems that the rate of inflation very generally slowed down about 1951 or 1952. This last point is enforced by Table II, though this uses money income, part of the rise in which marked a rise in real income.

TABLE II

*Average Annually Compounded Rates of Rise in Money Income per Head of the Occupied Population*

| | Full span. | | Phase I. | | Phase II. | |
|---|---|---|---|---|---|---|
| | | % | | % | | % |
| United States | 1947–57 | 4·8 | 1947–51 | 6·9 | 1951–57 | 3·4 |
| New Zealand | 1947–57 | 6·6 | 1947–51 | 9·6 | 1951–57 | 4·7 |
| United Kingdom | 1947–57 | 6·8 | 1947–52 | 7·6 | 1952–57 | 6·1 |
| Netherlands | 1947–56 | 7·5 | 1947–51 | 8·3 | 1951–56 | 6·8 |
| West Germany | 1950–57 | 7·6 | | | 1951–57 | 5·8 |
| Sweden | 1947–56 | 7·9 | 1947–52 | 10·9 | 1952–56 | 4·4 |
| Australia | 1947–57 | 9·6 | 1947–51 | 16·1 | 1951–57 | 5·5 |
| France | 1949–57 | 11·5 | 1949–52 | 17·6 | 1952–57 | 8·0 |

4.2.2. It is natural to ask the question of fact, whether differences in the rate of inflation have been associated systematically with differences in the rate of growth of real income. One way to put the question is to compare different economies within the same, or much the same, span of time. This we do in Table III and Fig. 7: at least within this small number of countries no systematic relation appears.

TABLE III

*Average Annually Compounded Rates of Rise, 1956–57 on 1947–48, in* (1) *General Prices*, (2) *Real Income per Head of the Occupied Population*

| | (1) % | (2) % |
|---|---|---|
| Australia | 8·5 | 1·1 |
| France * | 5·6 | 5·5 |
| New Zealand | 5·2 | 1·8 |
| United Kingdom | 5·0 | 1·5 |
| Sweden | 4·8 | 2·8 |
| Netherlands | 4·3 | 3·4 |
| United States | 2·3 | 2·2 |
| West Germany † | 2·1 | 4·6 |

* Starting-point 1949–50.
† Starting-point 1950–51.

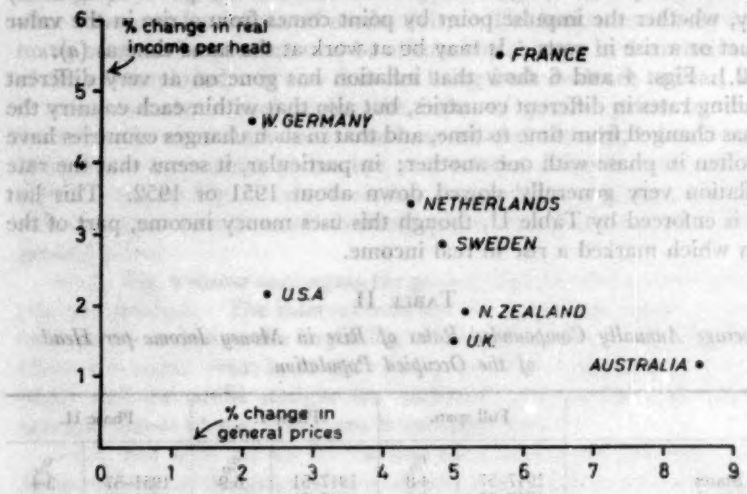



FIG. 7.—Indexes of general prices and of real income per head: average annually compounded rates of change, 1947/48 * to 1956/57.

* *France 1949/50. W. Germany 1950/51.*

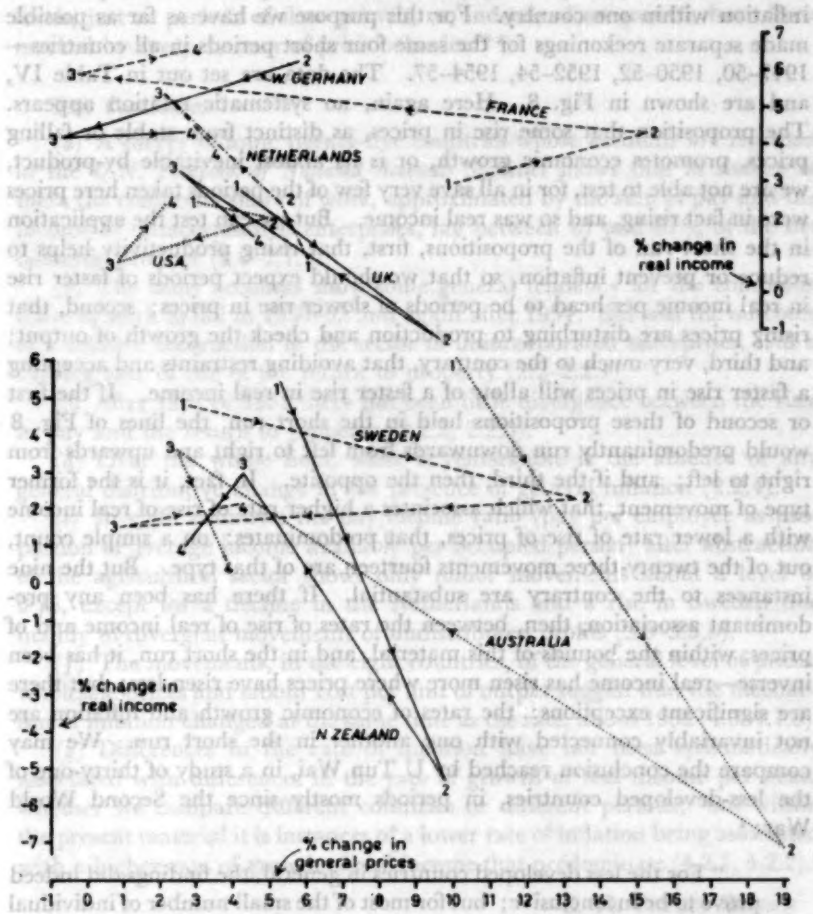
## TABLE IV

*Indexes of General Prices and of Real Income per Head: Average Annually Compounded Rates of Change, in Eight Countries, over Spans between 1947 and 1957*

Row 1. Index of General Prices } average annually compounded percentage rate of growth.
Row 2. Real Income per Head }

| Span. | | Australia. | France. | Netherlands. | New Zealand. | Sweden. | United Kingdom. | United States. | West Germany. |
|---|---|---|---|---|---|---|---|---|---|
| 1947/48 to 1956/57 | 1 | 8·5 | 5·6 * | 4·3 | 5·2 | 4·8 | 5·0 | 2·3 | 2·1 † |
| | 2 | 1·1 | 5·5 * | 3·4 | 1·8 | 2·8 | 1·5 | 2·2 | 4·6 † |
| 1947–50 | 1 | 10·0 | 10·0 * | 6·0 | 5·2 | 2·7 | 4·2 | 3·0 | |
| | 2 | 6·1 | 3·0 * | 1·0 | 5·4 | 4·8 | 2·8 | 2·5 | |
| 1950–52 | 1 | 19·0 | 15·2 | 5·3 | 9·9 | 13·3 | 9·6 | 4·9 | 5·8 |
| | 2 | −7·1 | 4·3 | 2·6 | −5·3 | 2·3 | −1·2 | 2·1 | 6·3 |
| 1952–54 | 1 | 2·4 | −0·3 | 2·1 | 4·3 | 0·8 | 2·5 | 0·8 | −0·7 |
| | 2 | 3·6 | 5·9 | 5·5 | 3·0 | 1·5 | 3·3 | 0·9 | 4·2 |
| 1954–57 | 1 | 3·7 | 2·8 | 3·6 | 2·5 | 4·1 | 4·5 | 2·0 | 2·7 |
| | 2 | 0·7 | 6·6 | 4·0 | 1·0 | 2·2 | 1·6 | 2·5 | 4·4 |

* Starting-point 1949.
† Starting-point 1950–51.




1. 1947–50 (France 1949–50).
2. 1950–52.
3. 1952–54.
4. 1954–57.

FIG. 8.—Indexes of general prices and real income per head: average annually compounded rates of change in four phases:

A second way to put the question is to compare different phases of inflation within one country. For this purpose we have as far as possible made separate reckonings for the same four short periods in all countries—1947–50, 1950–52, 1952–54, 1954–57. The data are set out in Table IV, and are shown in Fig. 8. Here again, no systematic relation appears. The proposition that some rise in prices, as distinct from stable or falling prices, promotes economic growth, or is its almost inevitable by-product, we are not able to test, for in all save very few of the periods taken here prices were in fact rising, and so was real income. But we can test the application in the short run of the propositions, first, that rising productivity helps to reduce or prevent inflation, so that we should expect periods of faster rise in real income per head to be periods of slower rise in prices; second, that rising prices are disturbing to production and check the growth of output; and third, very much to the contrary, that avoiding restraints and accepting a faster rise in prices will allow of a faster rise in real income. If the first or second of these propositions held in the short run, the lines of Fig. 8 would predominantly run downwards from left to right and upwards from right to left; and if the third, then the opposite. In fact, it is the former type of movement, that which associates a higher rate of rise of real income with a lower rate of rise of prices, that predominates: on a simple count, out of the twenty-three movements fourteen are of that type. But the nine instances to the contrary are substantial. If there has been any predominant association, then, between the rates of rise of real income and of prices, within the bounds of this material, and in the short run, it has been inverse—real income has risen more where prices have risen less; but there are significant exceptions: the rates of economic growth and inflation are not invariably connected with one another in the short run. We may compare the conclusion reached by U Tun Wai, in a study of thirty-one of the less-developed countries, in periods mostly since the Second World War: [1]

> " For the less developed countries in general, the findings did indeed prove to be inconclusive; but for most of the small number of individual countries for which the available statistics cover periods in which the rates of price increase differ significantly, the evidence suggests that the rate of growth was higher when the rate of inflation was lower."

The Report on Employment, Growth, and Price Levels, prepared in 1959 by the staff of the Joint Economic Committee of Congress, after surveying the record of eight advanced countries over the last 50 or 90 years, and of twelve since 1949, found that " there is no simple relationship between changes in output and changes in prices. Rapid economic growth has at

[1] U. Tun Wai, " The Relation between Inflation and Economic Development," *International Monetary Fund Staff Papers*, 7, 2, October 1959.

different times been associated with rising, constant, and falling price levels, just as periods of slow growth, or, indeed, of no growth, have been marked by every manner of price behavior." [1]

5.0. *Conclusions*

(*a*) A survey of some twenty-five countries whose accounts are reported in the *U.N. Yearbook of National Accounts Statistics* shows that in sixteen of them the composite share of work, approximated by the sum of pay and the income of unincorporated enterprises, lay between 81 and 87% of the net domestic product (2.0–2.1.2).

(*b*) The same accounts show some general tendency for the composite share of work to fall in 1950–52 and again after 1954: this was the outcome of a relative contraction of the sector of unincorporated enterprises, and a varying rate of rise of the return to property (2.2–2.2.1).

(*c*) After 1951 or 1952 there has been little divergence between the rises in pay and the return to property (2.2.2, 2.2.3).

(*d*) Over the whole field, what is remarkable is the absence of any general distributive change in the presence of general inflation (2.2.4).

(*e*) In eight countries the pay/income ratio (pay per employee as proportion of average income available per occupied person) after abstraction of the agricultural sector shows only minor movements about a level of 0·75, except for a decline in the Netherlands and a rise in Sweden due mainly to divergent movements of undistributed profits (3.0–3.3.5).

(*f*) The movements, in the eight countries, of the general level of prices, wholesale prices and labour cost per unit of output suggest that the mechanism of inflation changed at the same time as the rate, about 1952 (4.0–4.1.3).

(*g*) Differences in the rate of inflation have not been systematically associated with differences in the rate of growth of real income per head, whether we compare different countries or different periods; but within the present material it is instances of a lower rate of inflation being associated with a higher rate of growth of real income that predominate (4.2.1, 4.2.2).[2]

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[1] Joint Economic Committee, Congress of the United States, 86th Congress, 1st Session: Staff Report on Employment, Growth, and Price Levels, December 24, 1959, pp. 11–13.

[2] Appendix: see pp. 746–756.

# APPENDIX

## TABLE V

***Shares of* (1) *Pay of Employees*, (2) *Income of Unincorporated Enterprises*, (3) *Work as a Whole, as Approximated by* (1) + (2), *in Net Domestic Product; together with* (4), *Pay of Employees as Share of Net Domestic Product Outside the Sector of Unincorporated Enterprise***

Values in row 3 marked by asterisks are those taken as median, or central pair, for the purpose of Fig. 1.

SOURCE: *U.N. Yearbook of National Accounts Statistics*, 1957, 1958.

The net domestic product has been estimated by subtracting from "national income" (Table 3 of the Accounts) "net factor income from abroad" (Table 1 of the Accounts), where that is available. The subtraction has in effect been made wholly from property income, whereas part of it may actually consist of earnings.

The figures for Australia and New Zealand in this Table are for fiscal years beginning July 1 and April 1 respectively, and so differ somewhat from the figures for those countries in Table VII, which are for calendar years.

| | | 1950. | 1951. | 1952. | 1953. | 1954. | 1955. | 1956. | 1957. |
|---|---|---|---|---|---|---|---|---|---|
| Australia | 1 | 0·490 | 0·587 | 0·577 | 0·581 | 0·591 | 0·601 | 0·589 | 0·615 |
| | 2 | 0·345 | 0·282 | 0·278 | 0·249 | 0·229 | 0·214 | 0·222 | 0·199 |
| | 3 | 0·835 | 0·869 | 0·855 | 0·830* | 0·820* | 0·815 | 0·811 | 0·814 |
| | 4 | 0·748 | 0·818 | 0·799 | 0·774 | 0·766 | 0·764 | 0·757 | 0·768 |
| Belgium | 1 | 0·538 | 0·541 | 0·539 | 0·549 | 0·544 | 0·546 | 0·554 | 0·571 |
| | 2 | 0·342 | 0·322 | 0·306 | 0·313 | 0·308 | 0·303 | 0·292 | 0·287 |
| | 3 | 0·880 | 0·863 | 0·865 | 0·862* | 0·852 | 0·849 | 0·846 | 0·858* |
| | 4 | 0·818 | 0·797 | 0·605 | 0·799 | 0·786 | 0·783 | 0·783 | 0·801 |
| Brazil | 1 | 0·432 | 0·413 | 0·426 | 0·419 | 0·414 | 0·440 | 0·475 | 0·472 |
| | 2 | 0·432 | 0·424 | 0·434 | 0·427 | 0·425 | 0·420 | 0·396 | 0·406 |
| | 3 | 0·864 | 0·837 | 0·860* | 0·846 | 0·839 | 0·860* | 0·871 | 0·880 |
| | 4 | 0·760 | 0·717 | 0·753 | 0·731 | 0·720 | 0·758 | 0·786 | 0·797 |
| Canada | 1 | 0·586 | 0·607 | 0·605 | 0·634 | 0·661 | 0·646 | 0·644 | 0·669 |
| | 2 | 0·197 | 0·204 | 0·184 | 0·168 | 0·138 | 0·142 | 0·144 | 0·120 |
| | 3 | 0·783 | 0·811 | 0·789* | 0·802 | 0·799 | 0·788 | 0·788 | 0·789* |
| | 4 | 0·749 | 0·763 | 0·741 | 0·762 | 0·766 | 0·753 | 0·753 | 0·760 |
| Ceylon | 1 | 0·480 | 0·457 | 0·453 | 0·464 | 0·473 | 0·473 | 0·472 | 0·469 |
| | 2 | 0·384 | 0·389 | 0·377 | 0·383 | 0·383 | 0·378 | 0·356 | 0·351 |
| | 3 | 0·864 | 0·846* | 0·830 | 0·847* | 0·856 | 0·851 | 0·828 | 0·820 |
| | 4 | 0·779 | 0·748 | 0·727 | 0·752 | 0·766 | 0·760 | 0·733 | 0·723 |
| China (Taiwan) | 1 | | 0·414 | 0·402 | 0·384 | 0·439 | 0·409 | 0·409 | 0·413 |
| | 2 | | 0·397 | 0·409 | 0·433 | 0·375 | 0·375 | 0·360 | 0·353 |
| | 3 | | 0·811* | 0·811 | 0·817 | 0·814 | 0·784 | 0·769 | 0·766 |
| | 4 | | 0·687 | 0·680 | 0·677 | 0·702 | 0·655 | 0·640 | 0·639 |
| Colombia | 1 | 0·500 | 0·483 | 0·477 | 0·478 | 0·464 | 0·467 | 0·475 | 0·475 |
| | 2 | 0·304 | 0·298 | 0·321 | 0·339 | 0·338 | 0·319 | 0·331 | 0·337 |
| | 3 | 0·804* | 0·781 | 0·798 | 0·817 | 0·802* | 0·786 | 0·806* | 0·812 |
| | 4 | 0·719 | 0·688 | 0·703 | 0·723 | 0·701 | 0·686 | 0·710 | 0·717 |
| Costa Rica | 1 | 0·601 | 0·597 | 0·586 | 0·596 | 0·596 | 0·599 | 0·605 | 0·614 |
| | 2 | 0·300 | 0·297 | 0·296 | 0·293 | 0·286 | 0·282 | 0·266 | 0·273 |
| | 3 | 0·901 | 0·894 | 0·882 | 0·889 | 0·882* | 0·881 | 0·871 | 0·887* |
| | 4 | 0·859 | 0·849 | 0·833 | 0·842 | 0·835 | 0·835 | 0·824 | 0·844 |

TABLE V—*Continued*

| | | 1950. | 1951. | 1952. | 1953. | 1954. | 1955. | 1956. | 1957. |
|---|---|---|---|---|---|---|---|---|---|
| Cuba | 1 | | 0·603 | 0·661 | 0·660 | 0·645 | 0·628 | 0·629 | 0·604 |
| | 2 | | 0·196 | 0·164 | 0·184 | 0·186 | 0·186 | 0·182 | 0·188 |
| | 3 | | 0·799 | 0·825* | 0·844 | 0·831 | 0·814* | 0·811 | 0·792 |
| | 4 | | 0·750 | 0·790 | 0·809 | 0·792 | 0·771 | 0·769 | 0·744 |
| Ecuador | 1 | 0·479 | 0·480 | 0·442 | 0·454 | 0·463 | 0·479 | 0·475 | |
| | 2 | 0·223 | 0·225 | 0·251 | 0·244 | 0·235 | 0·228 | 0·222 | |
| | 3 | 0·702 | 0·705 | 0·693 | 0·698* | 0·698 | 0·707 | 0·697 | |
| | 4 | 0·616 | 0·619 | 0·590 | 0·600 | 0·605 | 0·621 | 0·611 | |
| Finland | 1 | 0·614 | 0·585 | 0·620 | 0·620 | 0·614 | 0·611 | 0·622 | 0·631 |
| | 2 | 0·250 | 0·261 | 0·242 | 0·244 | 0·243 | 0·239 | 0·235 | 0·226 |
| | 3 | 0·864 | 0·846 | 0·862 | 0·864 | 0·857 | 0·850 | 0·857* | 0·857* |
| | 4 | 0·819 | 0·793 | 0·818 | 0·820 | 0·811 | 0·803 | 0·813 | 0·815 |
| France | 1 | 0·548 | 0·559 | 0·570 | 0·568 | 0·582 | 0·577 | 0·588 | 0·586 |
| | 2 | 0·365 | 0·339 | 0·331 | 0·322 | 0·308 | 0·306 | 0·298 | 0·297 |
| | 3 | 0·913 | 0·898 | 0·901 | 0·890* | 0·890* | 0·883 | 0·886 | 0·883 |
| | 4 | 0·862 | 0·846 | 0·852 | 0·837 | 0·841 | 0·832 | 0·838 | 0·834 |
| Jamaica | 1 | | | | 0·578 | 0·570 | 0·575 | 0·573 | |
| | 2 | | | | 0·253 | 0·255 | 0·244 | 0·215 | |
| | 3 | | | | 0·831 | 0·825* | 0·819* | 0·788 | |
| | 4 | | | | 0·774 | 0·765 | 0·760 | 0·723 | |
| Japan | 1 | 0·418 | 0·418 | 0·447 | 0·473 | 0·496 | 0·482 | 0·491 | 0·489 |
| | 2 | 0·456 | 0·432 | 0·441 | 0·393 | 0·383 | 0·391 | 0·364 | 0·344 |
| | 3 | 0·874 | 0·850 | 0·888 | 0·866* | 0·879 | 0·873* | 0·855 | 0·833 |
| | 4 | 0·768 | 0·735 | 0·800 | 0·779 | 0·804 | 0·792 | 0·772 | 0·746 |
| Luxembourg | 1 | 0·589 | 0·508 | 0·508 | 0·496 | 0·583 | 0·555 | 0·565 | 0·566 |
| | 2 | 0·292 | 0·238 | 0·232 | 0·380 | 0·271 | 0·255 | 0·262 | 0·257 |
| | 3 | 0·881 | 0·746 | 0·740 | 0·876 | 0·854 | 0·810 | 0·827* | 0·823* |
| | 4 | 0·832 | 0·667 | 0·662 | 0·829 | 0·800 | 0·745 | 0·765 | 0·762 |
| Malta | 1 | | | | | 0·592 | 0·588 | 0·573 | 0·577 |
| | 2 | | | | | 0·302 | 0·308 | 0·326 | 0·327 |
| | 3 | | | | | 0·894 | 0·896* | 0·899* | 0·904 |
| | 4 | | | | | 0·848 | 0·850 | 0·851 | 0·858 |
| Mauritius | 1 | 0·525 | 0·546 | 0·540 | 0·525 | 0·530 | 0·515 | 0·503 | 0·498 |
| | 2 | 0·198 | 0·186 | 0·188 | 0·201 | 0·190 | 0·176 | 0·183 | 0·173 |
| | 3 | 0·723* | 0·732 | 0·728 | 0·726 | 0·720* | 0·691 | 0·686 | 0·671 |
| | 4 | 0·654 | 0·671 | 0·665 | 0·657 | 0·654 | 0·625 | 0·616 | 0·602 |
| New Zealand | 1 | 0·458 | 0·532 | 0·540 | 0·534 | 0·548 | 0·565 | 0·569 | 0·587 |
| | 2 | 0·363 | 0·276 | 0·278 | 0·276 | 0·262 | 0·255 | 0·254 | 0·239 |
| | 3 | 0·821 | 0·808 | 0·818* | 0·810 | 0·810 | 0·820* | 0·823 | 0·826 |
| | 4 | 0·719 | 0·735 | 0·748 | 0·737 | 0·742 | 0·758 | 0·763 | 0·771 |
| Puerto Rico | 1 | 0·629 | 0·649 | 0·670 | 0·668 | 0·667 | 0·656 | 0·671 | 0·671 |
| | 2 | 0·238 | 0·235 | 0·219 | 0·213 | 0·214 | 0·224 | 0·210 | 0·200 |
| | 3 | 0·867 | 0·884 | 0·889 | 0·881* | 0·881* | 0·880 | 0·881 | 0·871 |
| | 4 | 0·825 | 0·848 | 0·857 | 0·849 | 0·848 | 0·846 | 0·849 | 0·838 |
| Spain | 1 | | | | | 0·623 | | | |
| | 2 | | | | | 0·243 | | | |
| | 3 | | | | | 0·866 | | | |
| | 4 | | | | | 0·823 | | | |

TABLE V—*Continued*

| | | 1950. | 1951. | 1952. | 1953. | 1954. | 1955. | 1956. | 1957. |
|---|---|---|---|---|---|---|---|---|---|
| **Sweden** | 1 | 0·587 | 0·583 | 0·629 | 0·648 | 0·656 | 0·669 | 0·662 | 0·663 |
| | 2 | 0·205 | 0·188 | 0·191 | 0·191 | 0·190 | 0·181 | 0·172 | 0·167 |
| | 3 | 0·792 | 0·771 | 0·820 | 0·839 | 0·846 | 0·850 | 0·834* | 0·830* |
| | 4 | 0·738 | 0·718 | 0·776 | 0·801 | 0·810 | 0·817 | 0·800 | 0·796 |
| **Switzerland** | 1 | 0·595 | 0·623 | 0·631 | 0·632 | 0·625 | 0·623 | 0·629 | 0·629 |
| | 2 | 0·212 | 0·210 | 0·197 | 0·196 | 0·201 | 0·198 | 0·191 | 0·192 |
| | 3 | 0·807 | 0·833 | 0·828 | 0·828 | 0·826* | 0·821* | 0·820 | 0·821 |
| | 4 | 0·755 | 0·788 | 0·786 | 0·786 | 0·782 | 0·777 | 0·778 | 0·778 |
| **Trinidad and Tobago** | 1 | | 0·483 | 0·500 | 0·488 | 0·501 | 0·491 | 0·454 | 0·433 |
| | 2 | | 0·260 | 0·260 | 0·254 | 0·264 | 0·274 | 0·252 | 0·237 |
| | 3 | | 0·743* | 0·760 | 0·742 | 0·765 | 0·765 | 0·706 | 0·670 |
| | 4 | | 0·652 | 0·676 | 0·654 | 0·681 | 0·676 | 0·607 | 0·568 |
| **United Kingdom** | 1 | 0·738 | 0·737 | 0·723 | 0·718 | 0·719 | 0·740 | 0·744 | 0·745 |
| | 2 | 0·116 | 0·102 | 0·105 | 0·102 | 0·097 | 0·094 | 0·091 | 0·089 |
| | 3 | 0·854 | 0·839 | 0·828 | 0·820 | 0·816 | 0·834* | 0·835 | 0·834* |
| | 4 | 0·834 | 0·821 | 0·808 | 0·800 | 0·796 | 0·817 | 0·818 | 0·818 |
| **United States** | 1 | 0·650 | 0·653 | 0·675 | 0·692 | 0·698 | 0·688 | 0·703 | 0·712 |
| | 2 | 0·152 | 0·152 | 0·146 | 0·134 | 0·135 | 0·129 | 0·124 | 0·119 |
| | 3 | 0·802 | 0·805 | 0·821* | 0·826* | 0·833 | 0·817 | 0·827 | 0·831 |
| | 4 | 0·767 | 0·770 | 0·790 | 0·799 | 0·807 | 0·790 | 0·802 | 0·809 |
| **Mean of central 4 out of 18** | 3 | 0·854 | 0·839 | 0·835 | 0·840 | 0·842 | 0·838 | 0·831 | 0·830 |
| | 4 | 0·769 | 0·767 | 0·788 | 0·791 | 0·791 | 0·779 | 0·780 | 0·786 |

## TABLE VI

*Data for Fig. 3: Amounts in Current Money of* (1) *Pay,* (2) *Incomes of Unincorporated Enterprises,* (3) *Remaining Net Domestic Product* (U.N. Yearbook of National Accounts Statistics, *1957 and 1958*)

| | | 1950. | 1951. | 1952. | 1953. | 1954. | 1955. | 1956. | 1957. |
|---|---|---|---|---|---|---|---|---|---|
| Australia, million £A | 1 | 1,535 | 1,934 | 2,083 | 2,248 | 2,439 | 2,659 | 2,807 | 2,899 |
| | 2 | 1,078 | 928 | 1,002 | 961 | 943 | 948 | 1,059 | 934 |
| | 3 | 517 | 431 | 525 | 658 | 745 | 820 | 899 | 877 |
| Belgium, hundred million francs | 1 | 1,466 | 1,676 | 1,774 | 1,807 | 1,868 | 1,986 | 2,132 | 2,320 |
| | 2 | 933 | 997 | 970 | 1,027 | 1,060 | 1,103 | 1,124 | 1,166 |
| | 3 | 326 | 426 | 429 | 455 | 509 | 550 | 591 | 578 |
| Brazil, hundred million cruzeiros | 1 | 916 | 1,050 | 1,249 | 1,509 | 1,887 | 2,544 | 3,465 | 4,053 |
| | 2 | 916 | 1,081 | 1,272 | 1,538 | 1,934 | 2,424 | 2,898 | 3,500 |
| | 3 | 289 | 414 | 409 | 555 | 734 | 811 | 945 | 1,032 |
| Canada, million dollars | 1 | 8,448 | 10,304 | 11,478 | 12,419 | 12,799 | 13,609 | 15,143 | 16,301 |
| | 2 | 2,846 | 3,464 | 3,488 | 3,287 | 2,665 | 2,990 | 3,385 | 2,915 |
| | 3 | 3,131 | 3,201 | 4,004 | 3,881 | 3,901 | 4,467 | 4,980 | 5,148 |
| Finland, hundred million markka | 1 | 2,549 | 3,599 | 3,800 | 3,813 | 4,188 | 4,705 | 5,394 | 5,691 |
| | 2 | 1,041 | 1,610 | 1,485 | 1,503 | 1,659 | 1,837 | 2,048 | 2,031 |
| | 3 | 564 | 940 | 845 | 838 | 973 | 1,157 | 1,237 | 1,292 |
| France, thousand million francs | 1 | 4,010 | 5,090 | 6,120 | 6,380 | 6,930 | 7,510 | 8,410 | 9,240 |
| | 2 | 2,670 | 3,080 | 3,560 | 3,610 | 3,660 | 3,990 | 4,260 | 4,690 |
| | 3 | 640 | 930 | 1,060 | 1,240 | 1,310 | 1,520 | 1,630 | 1,840 |
| Japan, thousand million yen | 1 | 1,415 | 1,819 | 2,222 | 2,679 | 2,983 | 3,139 | 3,616 | 4,057 |
| | 2 | 1,541 | 1,876 | 2,191 | 2,226 | 2,300 | 2,544 | 2,677 | 2,848 |
| | 3 | 428 | 654 | 554 | 759 | 726 | 826 | 1,068 | 1,385 |
| New Zealand, million £NZ | 1 | 284 | 336 | 359 | 396 | 443 | 480 | 508 | 552 |
| | 2 | 225 | 174 | 185 | 204 | 212 | 217 | 227 | 225 |
| | 3 | 111 | 121 | 121 | 141 | 154 | 153 | 158 | 164 |
| Sweden, ten million kroner | 1 | 1,559 | 1,890 | 2,228 | 2,310 | 2,453 | 2,689 | 2,888 | 3,109 |
| | 2 | 543 | 610 | 677 | 680 | 711 | 729 | 752 | 781 |
| | 3 | 553 | 743 | 636 | 573 | 575 | 604 | 722 | 797 |
| Switzerland, ten million francs | 1 | 1,044 | 1,153 | 1,238 | 1,290 | 1,355 | 1,444 | 1,559 | 1,651 |
| | 2 | 372 | 389 | 388 | 400 | 436 | 461 | 473 | 503 |
| | 3 | 339 | 310 | 337 | 351 | 378 | 414 | 445 | 470 |
| United Kingdom, million £ | 1 | 7,603 | 8,459 | 9,112 | 9,608 | 10,263 | 11,203 | 12,201 | 12,942 |
| | 2 | 1,190 | 1,171 | 1,322 | 1,372 | 1,381 | 1,435 | 1,487 | 1,556 |
| | 3 | 1,509 | 1,845 | 2,165 | 2,404 | 2,632 | 2,510 | 2,713 | 2,880 |
| United States, hundred million dollars | 1 | 1,547 | 1,808 | 1,960 | 2,097 | 2,084 | 2,247 | 2,427 | 2,555 |
| | 2 | 361 | 423 | 422 | 407 | 404 | 422 | 424 | 430 |
| | 3 | 472 | 540 | 521 | 528 | 499 | 597 | 599 | 605 |

## TABLE VII

*Money and Real Income per Head of Whole Occupied Population, and Components of the Pay/Income Ratio in the Agricultural Sector, the Rest of the Economy and the Whole Economy, in Eight Countries, 1947–57*

For SOURCES, see notes at end.

MATERIALS FOR FIGS. 4, 6

1. Composite index, base 1953, of general level of prices of final output.
2. (18) ÷ (1), viz., real income per head of occupied population in units of currency of purchasing power of 1953.
3. Average labour cost per unit of product, approximated by (17) ÷ (2), as index, 1953 = 100.
4. Index of wholesale prices.

PAY/INCOME RATIO: AGRICULTURAL SECTOR

5. Share of pay in total income of the sector, %.
6. Proportion of employees among total occupied in the sector, %.
7. Average pay per employee in the sector.
8. Average income per person occupied in the sector.
9. (5) ÷ (6) = (7) ÷ (8) = pay/income ratio in the sector, %.

PAY/INCOME RATIO: REST OF THE ECONOMY

10. Share of pay in total income of the sector, %.
11. Proportion of employees among total occupied in the sector, %.
12. Average pay per employee in the sector.
13. Average income per person occupied in the sector.
14. (10) ÷ (11) = (12) ÷ (13) = pay/income ratio in the sector, %.

PAY/INCOME RATIO: WHOLE ECONOMY

15. Share of pay in total income, %.
16. Proportion of employees among total occupied, %.
17. Average pay per employee.
18. Average income per occupied person.
19. (15) ÷ (16) = (17) ÷ (18) = pay/income ratio, %.

| | 1947. | 1948. | 1949. | 1950. | 1951. | 1952. | 1953. | 1954. | 1955. | 1956. | 1957. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | AUSTRALIA. Unit of currency in rows 2, 7, 8, 12, 13, 17, 18: £A. | | | | | | | | | | |
| 1 | 511 | 555 | 614 | 679 | 822 | 961 | 1,000 | 1,008 | 1,039 | 1,096 | 1,125 |
| 2 | 949 | 1,007 | 1,018 | 1,133 | 1,071 | 988 | 1,033 | 1,061 | 1,074 | 1,078 | 1,081 |
| 3 | 48 | 52 | 57 | 59 | 76 | 96 | 100 | 102 | 106 | 112 | 116 |
| 4 | 47 | 53 | 59 | 69 | 85 | 98 | 100 | 99 | 102 | 106 | 107 |
| 5 | | | | 8 | 10 | 14 | 15 | 18 | 20 | 19 | |
| 6 | 41 | 42 | 42 | 42·5 | 42·5 | 43 | 42·5 | 43 | 42·5 | 42 | |
| 7 | | | | 270·8 | 343·7 | 433·0 | 492·3 | 540·4 | 583·3 | 586·4 | |
| 8 | | | | 1,450·1 | 1,472·3 | 1,311·1 | 1,377·7 | 1,255·4 | 1,222·9 | 1,323·0 | |
| 9 | | | | 18·7 | 23·3 | 33·0 | 35·7 | 43·0 | 47·7 | 44·3 | |
| 10 | | | | 65·9 | 67·0 | 68·8 | 68·0 | 66·9 | 66·9 | 67·0 | |
| 11 | | | | 87·2 | 87·5 | 87·6 | 87·4 | 87·2 | 87·3 | 87·4 | |
| 12 | | | | 523·3 | 629·0 | 693·6 | 757·6 | 827·8 | 868·8 | 905·3 | |
| 13 | | | | 692·5 | 820·6 | 883·8 | 974·1 | 1,078·4 | 1,133·2 | 1,180·8 | |
| 14 | | | | 75·6 | 76·6 | 78·5 | 77·8 | 76·8 | 76·7 | 76·7 | |
| 15 | 55·1 | 54·5 | 54·8 | 51·7 | 55·0 | 59·2 | 58·9 | 59·7 | 60·7 | 60·6 | 61·3 |
| 16 | 80·7 | 81·1 | 81·3 | 81·8 | 82·1 | 81·9 | 81·6 | 81·9 | 82·2 | 82·2 | 82·1 |
| 17 | 331 | 376 | 421 | 486 | 590 | 686 | 746 | 780 | 825 | 870 | 909 |
| 18 | 485 | 559 | 625 | 769 | 880 | 949 | 1,033 | 1,069 | 1,116 | 1,181 | 1,216 |
| 19 | 68·2 | 67·3 | 67·4 | 63·2 | 67·0 | 72·3 | 72·2 | 73·0 | 73·9 | 73·7 | 74·7 |

TABLE VII—*continued*

| | 1947. | 1948. | 1949. | 1950. | 1951. | 1952. | 1953. | 1954. | 1955. | 1956. | 1957. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | FRANCE. Unit of currency in 2, 7, 8, 12, 13, 17, 18: '000 francs. | | | | | | | | | | |
| 1 | | | 692 | 761 | 912 | 1,010 | 1,000 | 1,004 | 1,018 | 1,048 | 1,089 |
| 2 | | | 563 | 580 | 587 | 631 | 654 | 707 | 763 | 813 | 857 |
| 3 | | | 66 | 72 | 90 | 99 | 100 | 98 | 99 | 104 | 106 |
| 4 | 37 | 65 | 72 | 78 | 100 | 105 | 100 | 98 | 98 | 102 | 108 |
| 5 | | | | 13 | 14 | 14 | 14 | 14 | 14 | 15 | 14 |
| 6 | | | | 33 | 34 | 35·5 | 35·5 | 35·5 | 38 | 38·5 | 36 |
| 7 | | | | 149·1 | 172·7 | 191·8 | 200·0 | 209·1 | 200·0 | 208·3 | 245·4 |
| 8 | | | | 370·3 | 425·0 | 491·9 | 520·0 | 525·8 | 538·7 | 550·6 | 632·3 |
| 9 | | | | 40·3 | 40·6 | 39·0 | 38·5 | 39·8 | 37·1 | 37·8 | 38·8 |
| 10 | | | | 63·4 | 65·6 | 65·7 | 66·9 | 65·6 | 64·3 | 65·2 | 65·1 |
| 11 | | | | 84·1 | 84·1 | 83·6 | 83·6 | 84·5 | 83·8 | 83·8 | 84·8 |
| 12 | | | | 346·1 | 441·4 | 527·0 | 548·8 | 582·6 | 637·7 | 715·8 | 766·7 |
| 13 | | | | 459·2 | 565·8 | 669·8 | 685·7 | 751·5 | 830·9 | 920·8 | 998·8 |
| 14 | | | | 75·4 | 78·0 | 78·7 | 80·0 | 77·5 | 76·7 | 77·7 | 76·8 |
| 15 | 52·1 | 53·9 | 55·6 | 55·0 | 57·6 | 58·2 | 59·0 | 58·4 | 57·9 | 59·1 | 58·9 |
| 16 | 72·7 | 73·3 | 73·9 | 73·9 | 73·9 | 74·5 | 74·5 | 75·4 | 75·4 | 75·4 | 76·2 |
| 17 | 147·5 | 242·1 | 293·0 | 328·4 | 417·2 | 497·0 | 517·6 | 550·0 | 596·0 | 667·5 | 721·9 |
| 18 | 206·1 | 329·6 | 389·4 | 441·4 | 535·0 | 636·6 | 654·2 | 709·6 | 776·6 | 852·1 | 933·3 |
| 19 | 71·6 | 73·4 | 75·2 | 74·4 | 78·0 | 78·1 | 79·1 | 77·5 | 76·7 | 78·3 | 77·3 |

| | 1947. | 1948. | 1949. | 1950. | 1951. | 1952. | 1953. | 1954. | 1955. | 1956. | 1957. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | NETHERLANDS. Unit of currency in rows 2, 7, 8, 12, 13, 17, 18: guilders. | | | | | | | | | | |
| 1 | 758 | 780 | 826 | 904 | 995 | 1,002 | 1,000 | 1,044 | 1,066 | 1,088 | 1,160 |
| 2 | 4,538 | 4,535 | 4,699 | 4,673 | 4,751 | 4,917 | 5,203 | 5,471 | 5,845 | 6,051 | 6,162 |
| 3 | 82 | 87 | 86 | 93 | 102 | 102 | 100 | 104 | 105 | 109 | 126 |
| 4 | 72 | 75 | 78 | 87 | 107 | 104 | 100 | 101 | 102 | 104 | 107 |
| 5 | | 25·1 | 22·5 | 21·4 | 21·5 | 20·2 | 22·9 | 21·8 | 21·4 | 22·0 | 21·1 |
| 6 | | 35·9 | 35·1 | 34·2 | 34·2 | 34·2 | 33·3 | 32·4 | 32·4 | 32·4 | 32·4 |
| 7 | | 311 | 329 | 365 | 400 | 422 | 446 | 486 | 517 | 542 | 608 |
| 8 | | 446 | 512 | 585 | 637 | 713 | 648 | 724 | 784 | 797 | 935 |
| 9 | | 69·9 | 64·2 | 62·5 | 62·8 | 59·1 | 68·8 | 67·1 | 65·9 | 67·9 | 65·0 |
| 10 | | 64·5 | 60·9 | 60·8 | 60·4 | 60·6 | 58·3 | 58·5 | 57·9 | 59·1 | 60·0 |
| 11 | | 85·3 | 85·6 | 85·9 | 86·0 | 86·0 | 86·4 | 86·9 | 87·3 | 87·5 | 87·7 |
| 12 | | 2,585 | 2,646 | 2,854 | 3,181 | 3,286 | 3,408 | 3,734 | 4,023 | 4,345 | 4,739 |
| 13 | | 3,419 | 3,723 | 4,030 | 4,532 | 4,667 | 5,051 | 5,547 | 6,062 | 6,440 | 6,926 |
| 14 | | 75·6 | 71·1 | 70·8 | 70·2 | 70·4 | 67·5 | 67·3 | 66·4 | 67·5 | 68·4 |
| 15 | 56·3 | 58·8 | 55·3 | 55·0 | 54·8 | 54·4 | 53·8 | 53·9 | 53·5 | 54·9 | 55·4 |
| 16 | 78·6 | 79·6 | 80·1 | 80·3 | 80·5 | 80·6 | 81·0 | 81·6 | 82·0 | 82·4 | 82·7 |
| 17 | 2,463 | 2,612 | 2,681 | 2,890 | 3,218 | 3,328 | 3,457 | 3,778 | 4,066 | 4,384 | 4,787 |
| 18 | 3,440 | 3,537 | 3,881 | 4,224 | 4,727 | 4,927 | 5,203 | 5,712 | 6,231 | 6,583 | 7,148 |
| 19 | 71·6 | 73·8 | 69·1 | 68·4 | 68·1 | 67·5 | 66·4 | 66·1 | 65·2 | 66·6 | 67·0 |

TABLE VII—*continued*

| | 1947. | 1948. | 1949. | 1950. | 1951. | 1952. | 1953. | 1954. | 1955. | 1956. | 1957. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | NEW ZEALAND. Unit of currency in rows 2, 7, 8, 12, 13, 17, 18: £NZ. | | | | | | | | | | |
| 1 | 683 | 733 | 754 | 796 | 892 | 961 | 1,000 | 1,045 | 1,067 | 1,105 | 1,126 |
| 2 | 854 | 812 | 862 | 999 | 944 | 901 | 933 | 955 | 975 | 974 | 983 |
| 3 | 67 | 75 | 76 | 72 | 87 | 97 | 100 | 106 | 111 | 116 | 121 |
| 4 | 65 | 72 | 72 | 78 | 91 | 101 | 100 | 99 | 100 | 104 | 105 |
| 5 | 19·3 | 19·6 | 17·2 | 11·6 | 15·5 | 17·8 | 17·1 | 17·5 | 17·7 | 17·4 | 18·5 |
| 6 | 45 | 44 | 43 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 |
| 7 | 292·9 | 325·4 | 342·6 | 371·7 | 424·5 | 460·7 | 475·5 | 505·7 | 517·0 | 517·0 | 534·0 |
| 8 | 686·7 | 731·2 | 860·0 | 1,342·9 | 1,154·8 | 1,086·5 | 1,170·2 | 1,216·7 | 1,225·4 | 1,249·2 | 1,216·7 |
| 9 | 42·6 | 44·5 | 39·8 | 27·7 | 36·8 | 42·4 | 40·6 | 41·6 | 42·2 | 41·4 | 43·9 |
| 10 | 60·1 | 63·9 | 64·7 | 62·8 | 63·2 | 64·3 | 64·0 | 64·3 | 65·7 | 66·2 | 67·1 |
| 11 | 84·2 | 84·4 | 84·8 | 85·9 | 86·1 | 86·5 | 86·6 | 86·3 | 86·9 | 87·5 | 87·5 |
| 12 | 400·1 | 428·4 | 461·9 | 497·1 | 570·7 | 610·2 | 655·1 | 713·1 | 759·7 | 789·2 | 834·1 |
| 13 | 560·2 | 565·3 | 604·8 | 680·5 | 778·0 | 820·9 | 886·6 | 956·5 | 1,005·5 | 1,043·7 | 1,087·0 |
| 14 | 71·4 | 75·8 | 76·4 | 73·0 | 73·4 | 74·3 | 73·9 | 74·5 | 75·5 | 75·6 | 76·7 |
| 15 | 51·6 | 54·3 | 53·8 | 47·8 | 52·0 | 54·5 | 54·3 | 55·2 | 56·8 | 57·4 | 59·0 |
| 16 | 77·4 | 77·9 | 78·2 | 78·0 | 79·5 | 79·3 | 79·6 | 79·5 | 80·0 | 80·5 | 80·6 |
| 17 | 388·5 | 414·5 | 447 | 488 | 558 | 595 | 636 | 693 | 738 | 767 | 810 |
| 18 | 583 | 595 | 650 | 795 | 842 | 866 | 933 | 998 | 1,040 | 1,076 | 1,107 |
| 19 | 66·7 | 69·6 | 68·8 | 61·4 | 66·3 | 68·7 | 68·2 | 69·4 | 71·0 | 71·3 | 73·2 |

| | 1947. | 1948. | 1949. | 1950. | 1951. | 1952. | 1953. | 1954. | 1955. | 1956. | 1957. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SWEDEN. Unit of currency in rows, 2, 7, 8, 12, 13, 17, 18: kronen. | | | | | | | | | | |
| 1 | 717 | 751 | 761 | 776 | 920 | 996 | 1,000 | 1,011 | 1,046 | 1,100 | 1,142 |
| 2 | 8,099 | 8,557 | 8,874 | 9,331 | 9,610 | 9,771 | 9,801 | 10,066 | 10,261 | 10,505 | 10,756 |
| 3 | 67 | 70 | 70 | 70 | 83 | 96 | 100 | 102 | 107 | 111 | 98 |
| 4 | 67 | 72 | 72 | 76 | 100 | 106 | 100 | 99 | 103 | 108 | 110 |
| 5 | 40 | 41 | 39 | 38 | 37 | 39 | 40 | 41 | 41 | 40 | 41 |
| 6 | 51 | 51 | 50 | 48 | 49 | 49 | 49 | 49·5 | 49 | 48 | 48 |
| 7 | 2,678 | 3,055 | 3,158 | 3,277 | 3,822 | 4,765 | 4,833 | 5,141 | 5,549 | 5,847 | 6,001 |
| 8 | 3,461 | 3,815 | 3,998 | 4,214 | 5,087 | 6,019 | 5,936 | 6,271 | 6,636 | 7,018 | 7,056 |
| 9 | 77·4 | 80·1 | 79·0 | 77·8 | 75·1 | 79·2 | 81·4 | 82·0 | 83·6 | 83·3 | 85·0 |
| 10 | 70·6 | 70·5 | 70·3 | 67·8 | 67·4 | 73·4 | 75·7 | 76·2 | 77·7 | 77·0 | 80·9 |
| 11 | 91·7 | 91·8 | 91·7 | 91·6 | 91·6 | 91·9 | 91·7 | 91·8 | 91·9 | 92·1 | 92·3 |
| 12 | 4,929 | 5,430 | 5,629 | 5,881 | 7,161 | 8,466 | 8,804 | 9,169 | 9,801 | 10,418 | 11,639 |
| 13 | 6,404 | 7,069 | 7,344 | 7,943 | 9,727 | 10,597 | 10,666 | 11,038 | 11,599 | 12,462 | 13,275 |
| 14 | 77·0 | 76·8 | 76·6 | 74·0 | 73·6 | 79·9 | 82·5 | 83·1 | 84·5 | 83·6 | 87·6 |
| 15 | 66·9 | 67·0 | 66·1 | 64·5 | 64·1 | 69·4 | 71·7 | 72·3 | 73·7 | 73·3 | 73·5 |
| 16 | 83·5 | 83·7 | 83·5 | 83·5 | 83·5 | 83·8 | 83·9 | 84·1 | 84·5 | 84·8 | 85·2 |
| 17 | 4,649 | 5,146 | 5,342 | 5,598 | 6,785 | 8,056 | 8,377 | 8,741 | 9,370 | 9,985 | 10,592 |
| 18 | 5,807 | 6,426 | 6,753 | 7,241 | 8,841 | 9,732 | 9,801 | 10,177 | 10,733 | 11,555 | 12,283 |
| 19 | 80·0 | 80·1 | 79·1 | 77·3 | 76·7 | 82·8 | 85·5 | 85·9 | 87·3 | 86·4 | 86·2 |

TABLE VII—*continued*

| | 1947. | 1948. | 1949. | 1950. | 1951. | 1952. | 1953. | 1954. | 1955. | 1956. | 1957. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | UNITED KINGDOM. Unit of currency in rows 2, 7, 8, 12, 13, 17, 18: £. | | | | | | | | | | |
| 1 | 716 | 760 | 782 | 809 | 897 | 971 | 1,000 | 1,021 | 1,063 | 1,124 | 1,166 |
| 2 | 524 | 545 | 564 | 569 | 553 | 556 | 573 | 593 | 594 | 604 | 622 |
| 3 | 73 | 76 | 78 | 81 | 92 | 99 | 100 | 102 | 109 | 116 | 119 |
| 4 | 58 | 67 | 70 | 80 | 97 | 100 | 100 | 101 | 104 | 108 | 112 |
| 5 | | 49 | 43 | 42 | 40·5 | 40 | 40 | 42 | 42 | 42 | [41·5] |
| 6 | | 68 | 64 | 64 | 63·5 | 63 | 62 | 62 | 60·5 | 60 | 60 |
| 7 | | 336 | 329 | 313 | 337 | 361 | 386 | 362 | 421 | 456 | 481 |
| 8 | | 470 | 483 | 479 | 529 | 573 | 599 | 588 | 612 | 646 | 691 |
| 9 | | 71·5 | 68·1 | 65·3 | 63·7 | 63·0 | 64·4 | 67·9 | 68·8 | 70·6 | 69·6 |
| 10 | | 72·6 | 72·8 | 72·9 | 74·1 | 73·6 | 72·5 | 72·1 | 74·6 | 74·8 | 74·9 |
| 11 | | 93·7 | 93·5 | 93·6 | 93·4 | 93·6 | 93·7 | 93·9 | 94·0 | 94·0 | 94·9 |
| 12 | | 318·0 | 340·8 | 356·8 | 391·4 | 422·7 | 441·9 | 464·8 | 501·2 | 541·3 | 573·1 |
| 13 | | 410·6 | 437·9 | 458·2 | 493·4 | 537·7 | 571·1 | 604·9 | 631·6 | 679·7 | 725·9 |
| 14 | | 77·4 | 77·8 | 77·9 | 79·3 | 78·6 | 77·4 | 76·8 | 79·3 | 79·6 | 78·9 |
| 15 | 72·2 | 71·2 | 71·1 | 71·2 | 72·3 | 71·8 | 70·9 | 70·8 | 73·1 | 73·5 | 73·5 |
| 16 | 92·2 | 92·5 | 92·0 | 92·1 | 92·0 | 92·1 | 92·3 | 92·4 | 92·5 | 92·5 | 93·4 |
| 17 | 293·1 | 318·7 | 340·4 | 355·3 | 389·6 | 420·7 | 440·1 | 462·7 | 498·8 | 538·9 | 570·6 |
| 18 | 374·5 | 414·2 | 440·6 | 459·7 | 495·6 | 539·8 | 573·0 | 604·6 | 631·2 | 678·8 | 725·0 |
| 19 | 78·3 | 76·9 | 77·3 | 77·2 | 78·6 | 77·9 | 76·8 | 76·5 | 79·0 | 79·4 | 78·7 |

| | 1947. | 1948. | 1949. | 1950. | 1951. | 1952. | 1953. | 1954. | 1955. | 1956. | 1957. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | UNITED STATES. Unit of currency in rows 2, 7, 8, 12, 13, 17, 18: $. | | | | | | | | | | |
| 1 | 822 | 892 | 882 | 898 | 970 | 988 | 1,000 | 1,003 | 1,008 | 1,033 | 1,065 |
| 2 | 4,145 | 4,205 | 4,184 | 4,464 | 4,580 | 4,651 | 4,715 | 4,741 | 5,003 | 5,046 | 5,102 |
| 3 | 82 | 87 | 90 | 89 | 94 | 98 | 100 | 102 | 101 | 105 | 108 |
| 4 | 88 | 95 | 90 | 94 | 104 | 101 | 100 | 100 | 101 | 104 | 107 |
| 5 | | | 17 | 16·5 | 15 | 15 | 15 | 16·5 | 17 | 18 | [18] |
| 6 | | 26 | 26 | 26 | 25·5 | 25·5 | 25·5 | 26 | 27 | 27 | 28 |
| 7 | | | 1,287 | 1,323 | 1,498 | 1,466 | 1,452 | 1,411 | 1,484 | 1,522 | |
| 8 | | | 1,916 | 2,048 | 2,524 | 2,496 | 2,286 | 2,216 | 2,235 | 2,331 | |
| 9 | | | 67·2 | 64·6 | 59·3 | 58·7 | 63·5 | 63·7 | 66·4 | 65·3 | |
| 10 | | | 69·2 | 67·9 | 68·9 | 70·8 | 71·9 | 72·1 | 71·3 | 72·6 | |
| 11 | | | 93·6 | 93·5 | 96·1 | 96·6 | 97·5 | 96·6 | 96·5 | 97·8 | |
| 12 | | | 2,959 | 3,135 | 3,384 | 3,573 | 3,711 | 3,797 | 3,974 | 4,103 | |
| 13 | | | 4,002 | 4,317 | 4,717 | 4,877 | 5,029 | 5,084 | 5,375 | 5,528 | |
| 14 | | | 73·9 | 72·6 | 71·7 | 73·3 | 73·8 | 74·7 | 73·9 | 74·2 | |
| 15 | 65·3 | 63·6 | 65·1 | 64·3 | 65·1 | 67·2 | 68·9 | 69·2 | 68·8 | 70·3 | 70·9 |
| 16 | 84·5 | 84·5 | 83·4 | 84·2 | 87·3 | 88·2 | 89·3 | 88·6 | 89·1 | 89·6 | 91·0 |
| 17 | 2,634 | 2,824 | 2,885 | 3,060 | 3,315 | 3,501 | 3,635 | 3,713 | 3,894 | 4,088 | 4,235 |
| 18 | 3,407 | 3,751 | 3,690 | 4,009 | 4,443 | 4,595 | 4,715 | 4,755 | 5,043 | 5,213 | 5,434 |
| 19 | 77·3 | 75·3 | 78·1 | 76·4 | 74·6 | 76·2 | 77·1 | 78·1 | 77·2 | 78·5 | 77·9 |

TABLE VII—*continued*

| | 1947. | 1948. | 1949. | 1950. | 1951. | 1952. | 1953. | 1954. | 1955. | 1956. | 1957. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | WEST GERMANY. Unit of currency in rows 2, 7, 8, 12, 13, 17, 18: D. mks. | | | | | | | | | | |
| 1 | | | | 907 | 989 | 1,015 | 1,000 | 1,001 | 1,026 | 1,062 | 1,084 |
| 2 | | | | 4,714 | 5,160 | 5,321 | 5,614 | 5,781 | 6,169 | 6,312 | 6,584 |
| 3 | | | | 91 | 98 | 99 | 100 | 101 | 102 | 107 | 110 |
| 4 | | | | 85 | 100 | 103 | 100 | 98 | 101 | 103 | 105 |
| 5 | | | | 13·5 | 13 | 12 | 13 | 13 | 13 | 14 | 13 |
| 6 | | | | 47 | 45 | 44 | 44 | 43 | 42 | 42 | 41 |
| 7 | | | | 1,045 | 1,301 | 1,361 | 1,456 | 1,547 | 1,705 | 1,993 | 2,185 |
| 8 | | | | 3,622 | 4,527 | 4,958 | 5,020 | 5,177 | 5,602 | 6,009 | 6,756 |
| 9 | | | | 28·9 | 28·7 | 27·5 | 29·0 | 29·9 | 30·4 | 33·2 | 32·3 |
| 10 | | | | 63·3 | 62·2 | 64·9 | 66·2 | 66·0 | 65·1 | 66·7 | 67·2 |
| 11 | | | | 86·1 | 87·2 | 87·3 | 87·2 | 88·3 | 88·9 | 88·5 | 89·2 |
| 12 | | | | 3,300 | 3,831 | 4,000 | 4,267 | 4,415 | 4,740 | 5,085 | 5,414 |
| 13 | | | | 4,490 | 5,370 | 5,380 | 5,620 | 5,900 | 6,470 | 6,750 | 7,187 |
| 14 | | | | 73·5 | 71·3 | 74·3 | 75·9 | 74·7 | 73·2 | 75·4 | 75·3 |
| 15 | | | | 59·1 | 58·5 | 58·6 | 60·1 | 61·3 | 60·8 | 62·1 | 62·3 |
| 16 | | | | 81·3 | 81·6 | 82·3 | 82·7 | 83·2 | 83·9 | 84·4 | 84·5 |
| 17 | | | | 3,107 | 3,662 | 3,842 | 4,083 | 4,260 | 4,587 | 4,933 | 5,266 |
| 18 | | | | 4,276 | 5,103 | 5,401 | 5,614 | 5,787 | 6,329 | 6,703 | 7,137 |
| 19 | | | | 72·7 | 71·8 | 71·1 | 72·7 | 73·6 | 72·5 | 73·6 | 73·8 |

## NOTES ON TABLE VII: (i) PRICE INDEXES

*General Sources.* For prices, *U.N. Statistical Yearbook*, 1953, 1957; *U.N. Monthly Bulletin of Statistics*, October 1959. For wages, *I.L.O. Yearbook of Labour Statistics*, 1953, 1957.

*Index of General Level of Prices of Final Output* made by combining indexes of cost of living, wholesale prices and wages with weights 8, 1, 1, respectively.

*Notes on Indexes of Wholesale Prices:* Australia, basic materials: home consumption of food (excluding onions and potatoes), farm products and industrial raw materials. Netherlands, New Zealand, Sweden, home-consumed goods, general. France, United States, West Germany, general. United Kingdom, general index, extrapolated through 1956–58 by wholesale price index, all manufactured products other than fuel, food and tobacco, in *O.E.E.C. General Statistics*, September 1959.

*Notes on Indexes of Wages:* Australia, minimum weekly rates for adults in mining, manufacturing, construction, commerce, transport, services; entries for 1957, 1958 extrapolated by index of weighted average of nominal weekly rates for adult males, in *Quarterly Summary of Australian Statistics*, March 1959. France, index of net monthly wages calculated from hourly rates, overtime and other supplements and family allowances, and after deduction of insurance contributions and tax: *Statistiques et Etudes Financières*, Suppléments 114, June 1958, and 130, October 1959. Netherlands, earnings of men per hour in manufacturing. New Zealand, minimum hourly rates for men in branches of mining, manufacturing, construction, commerce, transport, services. Sweden, average earnings per hour of men in mining and manufacturing. United Kingdom, rates for normal week, manual workers. United States, hourly wages of men and women in manufacturing. W. Germany, hourly earnings in manufacture and construction, *O.E.E.C. General Statistics*, September 1959.

## NOTES ON TABLE VII: (ii) ESTIMATES OF PAY/INCOME RATIO

### 1. DEFINITIONS

*Total Occupied:* All gainfully employed in jobs. Excludes unpaid family workers and the unemployed.

*Employees:* All wage and salary earners in jobs, including Armed Forces at home and abroad; domestic servants; part-time workers counted as whole units. Biennial series have been interpolated.

*National Income:* At Factor Cost net of capital consumption where given, or depreciation. Adjusted for stock revaluation. Including net income from abroad. Data given for financial years have been interpolated to give estimates for calendar years.

*Pay:* Includes wages in kind and employers' contributions to social security.

*Income from Agriculture:* Includes the value of rent where possible. Data for crop years have been interpolated to give estimates for calendar years.

### 2. Sources and Methods

In the notes below, minor discrepancies are not mentioned, and interpolations and extrapolations have been noted only for major items.

#### *Australia*

*Sources.* Census Reports 1947 and 1954 (C.R.47 and C.R.54). *Monthly Bulletin of Employment Statistics* (M.B.E.). Primary Industries Part I: Rural Industries (P.I.R.). Parliamentary Papers on National Income and Expenditure, 1946/47 to 1957/58 (N.I.E.); Table numbers refer to 1957/58 paper.

*Method.* (1) *Whole Economy: Employers and Self-employed:* C.R.47 and C.R.54 with interpolations and extrapolations. *Employees:* Non-rural and Armed Forces, M.B.E.; Rural, P.I.R., Table 144. Domestics: C.R.47 and C.R.54. *National Income:* N.I.E. ("Resident Income" as defined in Appendix A), Table VII, p. 21. *Pay:* N.I.E., Table I, p. 16. (2) *Farms. Total occupied:* P.I.R., Table 144. *Employees* including temporary workers: P.I.R., Table 144. *Income:* N.I.E., Table I, p. 16: includes operations of the Produce Boards (see Appendix D, Note 4). *Wages:* P.I.R., Table 145. No figures for rent.

#### *France*

*Sources. Recensement Général de la Population*, 1946 (R.G.46) and *Résultats du Sondage au 1/20 me.*, 1954. (R.G.S.54). *Annuaire Statistique de la France 1951–58* (A.S.F.).* *I.L.O., Year Book of Labour Statistics*; Unemployment Tables (I.L.O.). *Bulletin Mensuel de Statistique;* Quarterly Supplements, *Etudes statistiques* (E.S.).* O.E.E.C., *Bulletin of General Statistics*, March 1957, p. 53 (O.E.E.C.). *Statesman's Year Book*, 1946–58 (S.Y.). *Etudes et Conjoncture* (E.C.).* S. F. Nedzynski, "Factor Remuneration and Salaires Indirectes in the French National Wages Bill" (London, Ph.D. Thesis) (S.F.N.).

* Institut National de la Statistique et des Etudes Economiques.

*Method.* (1) *Whole Economy.* Lack of figures, differences of classification and the known defects of R.G.46 (see *Premiers Résultats Détaillés*, pp. XLII–XLIII, XLVII, LIX) entailed many interpolations, extrapolations and adjustments for *all categories of worker.* For general guidance: E.S., July/September 1956, "Evolution de la population active de la France entre 1906 et 1954"; July/September 1957, "La population active de la France 1954–57." R.G.S.54 was the main guide throughout. *Civil Employees:* R.G.46; R.G.S.54, O.E.E.C.; A.S.F., "Population Active, Emploi et Main d'œuvre," giving occasional returns from "l'Enquête Emploi," E.S. July/September 1957, p. 19 (estimates for 1957); I.L.O. *Armed Forces:* R.G.46; R.G.S.54; S.Y.; E.S. July/September 1956, p. 13, July/September 1957, p. 18; E.C. June 1957, pp. 625, 629. *Employers and Self-employed:* R.G.46; R.G.S.54; A.S.F., chapter cited above. *National Income and Pay.* A.S.F., especially 1956, 1958, "Revenu National et Grandeurs Associées"; guidance from S.F.N. No reference found to stock adjustment. (2) *Agriculture and Forestry: Employers and Self-employed, Employees.* Guidance from E.S. July/September 1956, p. 5; R.G.46; R.G.S.54; O.E.E.C.; A.F.S. 1957, p. 68 Table III; E.S., July/September 1957, p. 19 (estimate for 1957). *Income and Pay:* E.C., September/October 1951; December numbers 1952–57; May 1958; "Le Revenu d'Agriculture." The figures are said to be subject to a wide margin of error.

#### *Netherlands*

*Sources. Statistische en Econometrische Onderzoekingen* (S.E.O.). *O.E.E.C. Statistical Bulletin*, March 1957, p. 53 (O.E.E.C.). *I.L.O. Year Book of Labour Statistics* 1958 (I.L.O.). Netherlands Central Bureau of Statistics: *Statistical Studies No. 4*, for definitions used in National Accounting. *Maandschrift van het Centraal Bureau voor de Statistiek*, February 1960 (M.S.).

*Method.* (1) *Whole Economy. Total Occupied:* Figures are in man-years, and "employers and self-employed" include unpaid family workers (see M.S., p. 111) for whom the man-year basis involves a substantial reduction from actual numbers. Therefore, for *employers and self-employed*, I.L.O. (Census of 1947) was used all through, after comparison with O.E.E.C. *Employees* in man-years: M.S., p. 113, Staat 2, plus "Arbeiders op objecten voor aanvullende werken," p. 112, Staat 1. *National Income and Pay:* S.E.O., kw. 2 and 3, December 1958; S.E.O., kw.2, 1955. (2) *Agriculture, Forestry and Fishing:* for the reason given above, *Employers and Self-employed* from I.L.O. *Employees* in man-years: M.S., p. 113, Staat 2. *Income and Pay:* S.E.O., kw. 2 and 3, 1958, Tables 25 and 36.

#### *New Zealand*

*Sources. Monthly Abstract of Statistics* (M.A.S.). Census Reports 1945 and 1951 (C.R.45 and C.R.51). Preliminary Report on 1956 Census issued as supplement to M.A.S., November 1957 (C.R.P.56). Official Estimates of National Income and Expenditure (N.I.E.): the table numbers quoted refer to the 1958 volume. *I.L.O. Year Book of Labour Statistics:* Agricultural Wages (I.L.O.).

*Method.* (1) *Whole Economy. Total Occupied:* M.A.S.: "Estimated Distribution of the Total Labour Force" less unpaid family workers, C.R.45 and C.R.51. *Employees:* C.R.45, C.R.51, C.R.P.56 with interpolations and extrapolations. *National Income and Pay:* N.I.E., Table 3. No reference found to stock revaluation. (2) *Farming. Total occupied and Employees:* C.R.45, C.R.51, C.R.P.56 with interpolations and extrapolation. *Income,* including operations of the Produce Boards: N.I.E., Table 4, items 24 c, d and e. *Pay:* I.L.O. approximate average weekly wage × 50. No figures for rent.

*Sweden*

*Sources. Statistisk Årsbok för Sverige* (S.A.). Meddelanden från Konjunkturinstitutet, Serie B.27, 1958: *Nationalbokföring för Sverige 1938/39,* 1946–57 (N.B.).

*Method.* (1) *Whole Economy.* S.A., Annual tables: "Income Earners and Total Income by Industry" (Table 356 in 1959 volume) gives *Total Occupied and Employees. National Income:* N.B., Table 2, Alternative II, giving G.N.P. at factor cost; *less* depreciation Table 11, p. 38, item 8. *Pay:* N.B., Table 11, p. 34, IV. 4. (2) *Agriculture, Forestry and Fishing. Total occupied and Employees:* S.A., series quoted above. *Total Income: ibid., income of employers* plus *pay.* No figure for rent, but see Table 53, 1959 volume, for relative importance of rented and owner-operated holdings.

*United Kingdom*

*Sources. Annual Abstract of Statistics* (A.A.S.). Census Report 1951 One per Cent Sample (C.R.). Census of Population of Northern Ireland 1951: General Report (C.N.I). Government of Northern Ireland: *Digest of Statistics* (D.S.); *Ulster Year Book* (U.B.). *Blue Book on National Income and Expenditure* (B.B.).

*Method.* (1) *Whole Economy. Total Occupied:* Separately compiled for Great Britain and Northern Ireland. (*a*) Great Britain: A.A.S., Section V, "Distribution of Total Manpower," civil employment. (*b*) Northern Ireland: C.N.I., with U.B., 1956, p. xxxiv and D.S.(A.1) population figures, used with C.N.I, Table XXVII, as basis for "economically active," with annual deduction for unemployment, A.A.S. *Total occupied:* (a) + (b) + Armed Forces (United Kingdom), A.A.S. *Employees* (United Kingdom): A.A.S. Section V. *National Income:* B.B., 1956, 1958, Table 1. For 1947, depreciation: Table 60 in 1956. *Pay:* B.B. 1956, 1958, Table 1. (2) *Farming. Total occupied:* (*a*) Great Britain: A.A.S., Section V, "Distribution of Total Manpower," with deduction for forestry and fishing from C.R. (*b*) Northern Ireland: D.S., H., "Agricultural Manpower." *Employees* (United Kingdom): A.A.S. *Income* (United Kingdom): A.A.S., Section VI, Agriculture, "Farming net Income" plus "Cost of Labour" and "Rent and Interest." *Pay:* A.A.S., Section VI, Agriculture, "Cost of Labour."

*United States*

*Sources. Statistical Abstract of the U.S.A.* (S.A.U.); numbers refer to tables in 1958 volume. *Survey of Current Business,* July numbers (S.C.B.).

*Method.* (1) *Whole Economy. Total occupied:* S.A.U., 254, less unpaid family workers, S.A.U., 273. *Employees:* Industrial, S.A.U., 261; Farm, S.A.U., 270; Armed Forces, S.A.U., 254; Domestic, S.C.B.; "Average Number of Full and Part-time Workers by Industry." *National Income and Pay:* S.A.U., 386. (2) *Farming. Total occupied:* S.A.U., 270, less unpaid family workers, S.A.U., 273. *Employees:* S.A.U., 270. *Income:* S.A.U., 387. *Pay:* S.C.B.: "Compensation of Employees in Industry."

WEST GERMANY (*excluding the Saar and West Berlin*)

*Sources. Statistisches Jahrbuch für die Bundesrepublik Deutschland* 1950–1958 (S.J.). Organization for European Economic Cooperation, *Bulletin of General Statistics,* March 1957, p. 53 (O.E.E.C.). *I.L.O. Year Book of Labour Statistics* (I.L.O.).

*Method.* (1) *Whole Economy. Employers and Self-employed:* I.L.O. (Census of 1950); O.E.E.C.; interpolations and extrapolations. *Employees:* S.J., Section VII, B.4. *National Income:* S.J., Section XXIII, A.2. *Pay:* S.J., Section XXIII, A.1, "Bruttoeinkommen aus Unselbständiger Arbeit." (2) *Agriculture and Forestry. Employers and Self-employed:* I.L.O. (Census of 1950) carried through with deduction for fishing. *Employees:* S.J., Section VII, B.2. *Income:* S.J., Section XXIII, A,5, "Net domestic product at factor cost by industries" (includes fishing). *Pay:* I.L.O. "Agricultural Wages" giving minimum rates, cash only.* Full wage with board and lodging estimated on basis of full Austrian rates (I.L.O.) converted to D. marks through dollar exchange (O.E.E.C.).

* I.L.O. 1958 has a misprint in coding. I.L.O. have confirmed that the rates quoted are for the cash part of the wage.

# CAPITAL ACCUMULATION AND THE COURSE OF INDUSTRIALISATION, WITH SPECIAL REFERENCE TO JAPAN[1]

## I. Introduction

The Japanese economy succeeded in achieving rapid industrialisation from 1900 to the Second World War.[2] The course of industrialisation involved two different phases. The first was a structural change of industry and foreign trade, in which new non-agricultural industries of the capital-intensive type were brought into existence and expanded partly through a reduction in the proportion of labour employed in agriculture. The second phase of industrialisation was predominantly one of balanced growth of industry and foreign trade resulting in a rise in labour productivity in certain key sectors. Rapid diversification of production faced serious difficulties, particularly a shortage of capital, that is, a "weak accumulation" in Joan Robinson's sense,[3] and necessitated the lowering of real wages. In the period of balanced growth the fruits of "strong accumulation" could be reaped, and real wages were raised.

The purpose of this paper is, first, to show, by using a model, the reason why a rapid structural change forces an economy to fall into a situation of weak accumulation. Secondly, the effects of balanced growth will be contrasted with the effects of structural change. Thirdly, it will be demonstrated that reasonable factor-price differentials among industries are effective, as in the case of Japanese economic development, in lessening the difficulties of carrying out structural changes and speeding up industrialisation.

## II. A Model[4]

Let us suppose that an economy produces three types of goods, $X$ (agricultural goods), $Y$ (light industry goods) and $Z$ (heavy industry goods), with its existing two factors of production, $L$ (labour) and $C$ (capital). The production function of each type of commodity is of the following Douglasian type:

$$\left.\begin{aligned} P_X &= B_X(L_X)^{k_X}(C_X)^{j_X} \\ P_Y &= B_Y(L_Y)^{k_Y}(C_Y)^{j_Y} \\ P_Z &= B_Z(L_Z)^{k_Z}(C_Z)^{j_Z} \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots \quad (1)$$

[1] I am indebted to Sir Roy Harrod, Professors Alan Gleason, Martin Bronfenbrenner, Harry Oshima, Hiroshi Shibata and Miyohei Shinohara for their helpful comments on an earlier draft. The work of translating this paper into English was supported by the Ford Foundation as part of a project for promoting translation of Japanese economic articles.

[2] Kiyoshi Kojima, "Japanese Foreign Trade and Economic Growth; with Special Reference to the Terms of Trade," *The Annals of the Hitotsubashi Academy*, April 1958, pp. 143–68.

[3] Joan Robinson, *The Accumulation of Capital* (London, 1956), pp. 94–6.

[4] It is not intended to build a rigorous general equilibrium model but merely to explain the course and problem of industrialisation in Japan.

where $P_i$ ($i = X, Y, Z$) stands for the volume of output of each type of goods, $L_i$ and $C_i$ for labour and capital respectively used in each industry and $B_i$ is a constant. The production function is, for the sake of simplicity, based on the assumption of constant returns to scale, or in other words, that $k_i + j_i = 1$. It is further supposed that $\frac{j_x}{k_x} < \frac{j_y}{k_y} < \frac{j_z}{k_z}$, *i.e.*, $X$-industry is the least capital intensive, $Z$-industry the most capital intensive and $Y$-industry in an intermediate position, for every factor price ratio common to all industries.

Now, for the sake of illustration, let us suppose that $B_i = 1$; $L_i = 900$; $k_x = \frac{3}{4}$; $k_y = \frac{1}{2}$; and $k_z = \frac{1}{4}$ ($j_x = \frac{1}{4}$, $j_y = \frac{1}{2}$, $j_z = \frac{3}{4}$). Values for $C_i$ are selected in accordance with our assumption concerning varying degrees of capital intensity. For the sake of simplicity, only three values are selected for each industry. Then we may obtain column (2) of Table I.

TABLE I

*Production Functions, Factor Prices and Product Prices*

| (1) | (2) Production function. | | | | (3) Factor price. | | | (4) Product price. | |
|---|---|---|---|---|---|---|---|---|---|
| Method of production. | Capital, $C$. | Labour, $L$. | Technical co-efficient, $C : L$. | Output, $P$. | Labour, $f_L$. | Capital, $f_C$. | Factor price ratio, $f_L : f_C$. | In terms of labour, $\pi$. | In terms of capital, $\pi'$. |
| $X_1$ | 150 | 900 | 1 : 6 | 575 | 0·4791 | 0·9583 | 1 : 2 | 2·087 | 1·043 |
| $X_2$ | 200 | 900 | 1 : 4·5 | 618 | 0·5150 | 0·7725 | 1 : 1·5 | 1·942 | 1·294 |
| $X_3$ | 300 | 900 | 1 : 3 | 684 | 0·5700 | 0·5700 | 1 : 1 | 1·754 | 1·754 |
| $Y_1$ | 450 | 900 | 1 : 2 | 636 | 0·3533 | 0·7067 | 1 : 2 | 2·830 | 1·415 |
| $Y_2$ | 600 | 900 | 1 : 1·5 | 735 | 0·4083 | 0·6125 | 1 : 1·5 | 2·449 | 1·633 |
| $Y_3$ | 900 | 900 | 1 : 1 | 900 | 0·5000 | 0·5000 | 1 : 1 | 2·000 | 2·000 |
| $Z_1$ | 1,350 | 900 | 1 : $\frac{2}{3}$ | 1,220 | 0·3389 | 0·6778 | 1 : 2 | 2·951 | 1·475 |
| $Z_2$ | 1,800 | 900 | 1 : 0·5 | 1,510 | 0·4194 | 0·6291 | 1 : 1·5 | 2·384 | 1·589 |
| $Z_3$ | 2,700 | 900 | 1 : $\frac{1}{3}$ | 2,051 | 0·5697 | 0·5697 | 1 : 1 | 1·755 | 1·755 |

The prices of labour and capital, $f_{Li}$ and $f_{Ci}$, are assumed to be equal to their respective marginal productivities in terms of goods. Thus, we obtain

$$f_{Li} = k_i \cdot \frac{P_i}{L_i}$$
$$f_{Ci} = j_i \cdot \frac{P_i}{C_i} \qquad (i = X, Y, Z) \quad . \quad . \quad . \quad . \quad (2)$$

These factor prices and their ratio are calculated in column (3) of Table I.

Let us suppose that perfect competition prevails in factor markets. Factors of production move freely between industries and obtain equal reward in all industries. The cost per unit (= price) in terms of labour,

$\pi_i$, and that in terms of capital, $\pi_i'$ (column 4 of Table I), of each type of goods are respectively the reciprocal of the price of labour and capital.

$$\pi_i = \frac{1}{k_i} \cdot \frac{L_i}{P_i} \qquad (i = X, Y, Z) \quad . \quad . \quad . \quad . \quad (3)$$

$$\pi_i' = \frac{1}{j_i} \cdot \frac{C_i}{P_i} \qquad (i = X, Y, Z) \quad . \quad . \quad . \quad . \quad (3')$$

Let $\rho$ stand for the factor price ratio, $f_L/f_C$. According to the above equations, if a specific $\rho$ is given, the economy can determine the optimum method of production, $C_i/L_i$, and the prices $\pi_i$ and $\pi_i'$, of each type of goods.

We may find a " set " of optimum methods of production and price ratios of goods for each specific factor-price ratio. Three sets, $\alpha$, $\beta$ and $\gamma$, are illustrated in Table II.

TABLE II
*Production Set*

| | C. | L. | C : L. | P. |
|---|---|---|---|---|
| Set $\alpha$ ($f_L : f_C = 1 : 2$) | | | | |
| $X_1$ | 150 | 900 | 1 : 6 | 575 |
| $Y_1$ | 450 | 900 | 1 : 2 | 636 |
| $Z_1$ | 1,350 | 900 | 1 : $\frac{2}{3}$ | 1,220 |
| Set $\beta$ ($f_L : f_C = 1 : 1{\cdot}5$) | | | | |
| $X_2$ | 200 | 900 | 1 : 4·5 | 618 |
| $Y_2$ | 600 | 900 | 1 : 1·5 | 735 |
| $Z_2$ | 1,800 | 900 | 1 : 0·5 | 1,510 |
| Set $\gamma$ ($f_L : f_C = 1 : 1$) | | | | |
| $X_3$ | 300 | 900 | 1 : 3 | 684 |
| $Y_3$ | 900 | 900 | 1 : 1 | 900 |
| $Z_3$ | 2,700 | 900 | 1 : $\frac{1}{3}$ | 2,051 |

Now, how can the factors be allocated to our three types of industries? Let us suppose that all the available labour and capital are always fully employed and utilised. Then, it follows

$$\left.\begin{aligned} L &= L_X + L_Y + L_Z \\ C &= C_X + C_Y + C_Z \end{aligned}\right\} \quad . \quad . \quad . \quad . \quad . \quad (4)$$

where $L$ and $C$ are the total labour and capital of an economy at a given time. Let us call $x$, $y$ and $z$ labour allocation weights and let them stand for $L_X/L$, $L_Y/L$ and $L_Z/L$ respectively. Further, let $C_{i_\rho}/L_{i_\rho}$ stand for the optimum method of production under a specific factor price ratio, $\rho$. Then equations (4) can be rewritten as

$$\left.\begin{aligned} L &= L \cdot x + L \cdot y + L \cdot z \\ C &= \frac{C_{X_\rho}}{L_{X_\rho}} \cdot L \cdot x + \frac{C_{Y_\rho}}{L_{Y_\rho}} \cdot L \cdot y + \frac{C_{Z_\rho}}{L_{Z_\rho}} \cdot L \cdot z \end{aligned}\right\} \quad . \quad . \quad . \quad (5)$$

Since $x + y + z = 1$, the unknowns are two and the third is a residual. Then, factor allocation is determined according to the two equations (5)[1], and

[1] Alternatively, one may count $x + y + z = 1$ as an equation; and then, the three unknowns are determined by the three equations.

the output of each type of goods is also determined according to equations (1).[1]

Table II on page 759. shows some important relationships. First, in a production set, in order to shift labour resources from *X*- to *Y*-industry, and from *X*- and/or *Y*-industry to *Z*-industry, an economy needs more capital, since the capital intensiveness is least in *X*-industry, intermediate in *Y*-industry and most in *Z*-industry. In other words, in order to increase $y$ (the labour allocation weight for light-industry) by reducing $x$ (the labour allocation weight for agriculture), and also in order to increase $z$ (the labour allocation weight for heavy-industry) by reducing $x$ and/or $y$,[2] the same amount of labour for the economy as a whole requires a greater amount of capital, even though the capital–labour ratio for each industry remains

[1] A two-factors and two-goods case is shown in Fig. 1. The production functions of the two goods are represented by single isoquants, *XX* and *YY*, showing the combinations of labour and capital required to produce a unit of output. If the factor price ratio, $\rho$, is represented by the slope of the common tangent *MN* to the isoquants *XX* and *YY*, both goods are produced at the optimal factor

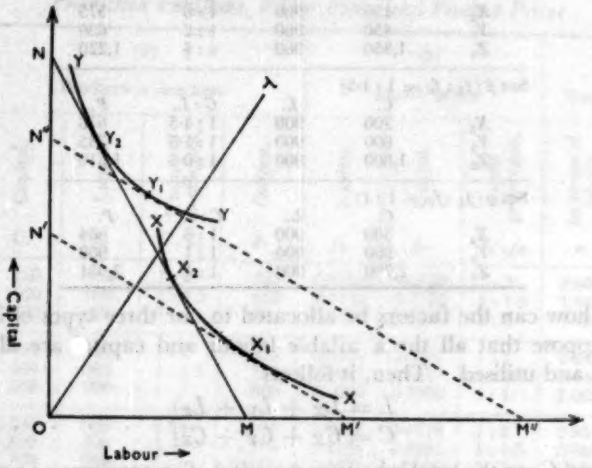


FIG. 1

combinations $X_2$ and $Y_2$, and their costs are the same (*OM* measured in terms of labour, *ON* measured in terms of capital). If the factor price ratio is represented by the slope of *M'N'* and *M''N''*, both being parallel to each other, the optimal factor combinations will be $X_1$ and $Y_1$ and the cost of *X*-goods will be cheaper than *Y*-goods. The capital labour proportions of the economy are represented by the slope of a $\lambda$ line. The closer is the $\lambda$ line to one of the optimal factor combinations, say $X_2$, the larger is the labour allocation weight, $x$, for that industry, and vice versa. In the following argument relationships between the shift of the optimal factor combinations and the change in the labour allocation weights for given change in the $\lambda$ line will be examined.

The diagrammatic representation here owes much to Professor H. G. Johnson's Preface to the Japanese edition of his *International Trade and Economic Growth*, translated by Kiyoshi Kojima and Hiroshi Shibata (Tokyo, 1960).

[2] It is also possible to increase $z$ by reducing $y$ and increasing $x$. This type of shift of resources is excluded from our diversification of production, since it involves the re-expansion of agriculture (*X*-industry).

constant.[1] This type of structural shift in labour resources may be called a *diversification of production*, which brings into existence and expands new industries of the capital intensive type in addition to the existing agricultural industries.

Secondly, as the production set is shifted from $\alpha$ to $\beta$ and from $\beta$ to $\gamma$, the efficiency of production of labour is increased and the real wage becomes higher as the capital–labour ratio rises in each industry. Let us call this type of change *rationalisation of production*. As in the diversification case, this also requires more capital in combination with one unit of labour for the economy as a whole.

Therefore, with given factor proportions, in shifting labour resources from a less capital-intensive industry to a more capital-intensive industry, or, in other words, in carrying out diversification of production in the above sense, the economy as a whole encounters a capital shortage and will have to derationalise each industry or shift the production set from $\gamma$ to $\beta$ and from $\beta$ to $\alpha$, in the direction of greater labour intensiveness and lower real wages. This is the situation of capital shortage or weak accumulation into which an economy falls during a structural change.

## III. Course of Industrialisation

The above model is useful in explaining the economic development process of a country as its factor proportion changes over time.[2] When the growth rate of capital is greater than that of population (more exactly, labour force), the factor proportion, or capital–labour ratio, of an economy increases. Let us assume that the economy passes through four stages of factor proportion, $150C/900L$ in stage A, $250C/900L$ in stage B, $400C/900L$ in stage C and $600C/900L$ in stage D.

There are a number of possible combinations of the three products, *X*-, *Y*- and *Z*-goods, for each factor proportion stage. However, the optimum factor allocation to industries from the point of view of full employment of labour and full utilisation of capital is governed by the two of three labour allocation weights, $x$, $y$ and $z$. It is easy to determine two labour allocation weights by making the third weight zero. Column (3) of Table III shows the value of $y$ when all factors are allocated only to *X*- and *Y*-industries. Similarly, column (4) shows the value of $z$ when all factors are allocated only to *X*- and *Z*-industries. Therefore, the labour allocation weight for *X*-industry is calculated by $(1 - y)$ and $(1 - z)$, which, as shown in column (5), provide us the lower and upper limits of $x$. For example, in the case of $[B_\alpha]$, which represents a case when the economy chooses production set $\alpha$ in factor proportion stage *B*, (*a*) the economy can expand *Y*-industry up to a

[1] This can be explained by an application of a theorem which T. M. Rybszynski first presented. See, "Factor Endowment and Relative Commodity Prices," *Economica*, Vol. XXII, No. 88, November 1955, pp. 336–41.

[2] The model is also useful in explaining the pattern of world trade by supposing the world consists of countries with different factor proportions.

point where $y$ is $\frac{1}{3}$ and contract $X$-industry to a point where $x$ is $\frac{2}{3}$ but maintain no $Z$-industry; ($b$) the economy can expand $Z$-industry until $z$ is $\frac{1}{11}$ and $X$-industry until $x$ is $\frac{11}{12}$ without any $Y$-industry; ($c$) if the economy wants to maintain three industries, $x$ should be more than $\frac{2}{3}$ and less than $\frac{11}{12}$.

TABLE III

*Factor Allocation Weight for Industries*

| (1) Stage of factor proportion. | (2) Production set chosen. | (3) Allocation weight for $Y$-industry when all factors are allocated to $X$- and $Y$-industries. | (4) Allocation weight for $Z$-industry when all factors are allocated to $X$- and $Z$-industries. | (5) Lower and upper limits of allocation weight for $X$-industry. |
|---|---|---|---|---|
| $A$ (150$C$ : 900$L$) | $[A_\alpha]$ | $y_1 = 0$ | $z_1 = 0$ | $x_1 = 1$ |
| $B$ (250$C$ : 900$L$) | $[B_\alpha]$<br>$[B_\beta]$ | $y_1 = \frac{1}{3}$<br>$y_2 = \frac{1}{3}$ | $z_1 = \frac{1}{11}$<br>$z_2 = \frac{1}{11}$ | $\frac{2}{3} \leqslant x_1 \leqslant \frac{11}{12}$<br>$\frac{2}{3} \leqslant x_2 \leqslant \frac{11}{12}$ |
| $C$ (400$C$ : 900$L$) | $[C_\alpha]$<br>$[C_\beta]$<br>$[C_\gamma]$ | $y_1 = \frac{4}{9}$<br>$y_2 = \frac{4}{9}$<br>$y_3 = \frac{4}{9}$ | $z_1 = \frac{4}{11}$<br>$z_2 = \frac{4}{11}$<br>$z_3 = \frac{4}{11}$ | $\frac{4}{9} \leqslant x_1 \leqslant \frac{11}{12}$<br>$\frac{4}{9} \leqslant x_2 \leqslant \frac{11}{12}$<br>$\frac{4}{9} \leqslant x_3 \leqslant \frac{11}{12}$ |
| $D$ (600$C$ : 900$L$) | $[D_\beta]$<br>$[D_\gamma]$ | $y_2 = \frac{1}{2}$<br>$y_3 = \frac{1}{2}$ | $z_2 = \frac{1}{2}$<br>$z_3 = \frac{1}{2}$ | $0 \leqslant x_2 \leqslant \frac{1}{2}$<br>$\frac{1}{2} \leqslant x_3 \leqslant \frac{1}{2}$ |

Now, column (5) of Table III will show an important difference in economic development, depending on whether the economy has a rationalisation preference or a diversification preference. First, as it moves through the different factor proportion stages corresponding to a growth of capital more rapid than that of labour, the economy can choose a course such as $[A_\alpha]$ to $[B_\beta]$, and then to $[C_\gamma]$. This may be called the rationalisation preference course, since the economy aims mainly at raising labour productivity by making each industry's production method more capital intensive. This course, however, cannot expand $Y$- and $Z$-industries so greatly as the diversification preference course, since both the lower and upper limits of $x$ decline slowly from 1 to $\frac{2}{3}$ to $\frac{4}{9}$, and from 1 to $\frac{11}{12}$ to $\frac{11}{12}$ respectively.

Alternatively, the economy can choose a course such as $[A_\alpha]$ to $[B_\alpha]$ to $[C_\alpha]$ as it increases capital relative to labour. This course may be called the diversification preference course, since the economy aims mainly at the maximum expansion of $Y$- and $Z$-industries. Both the lower and upper limits of $x$ decline from 1 to $\frac{2}{3}$ to $\frac{4}{9}$, and from 1 to $\frac{11}{12}$ to $\frac{11}{12}$. This course, however, will not make possible increases in labour productivity and real wages.

In short, given the growth rate of the capital–labour ratio, if the economy aims at the promotion of labour efficiency it has to refrain from expanding capital-intensive industries. Alternatively, if it aims at rapid structural changes towards expanding new industries of capital-intensive type not only will it be unable to raise greatly labour efficiency and real wages but also it will sometimes have to lower them by making all industries less capital

intensive. The latter is a serious difficulty of weak accumulation into which rapidly developing countries fall when the capital accumulation cannot keep up with the rapid structural change.

## IV. Application to Japanese Economic Development

The above model is helpful in explaining the course of Japanese economic development. Since certain necessary data are not yet available, this paper will attempt no more than to indicate the method of application.

The percentage of total gainful workers employed in agriculture in various periods in Japan [1] shows that the labour allocation weight for agriculture, $x$, decreased from 1 in period 0 (before 1878), to $\frac{7}{8}$ in period I (1878–1902), $\frac{5}{8}$ in period II (1903–13), $\frac{4}{8}$ in period III (1913–27), and $\frac{1}{2}$ in period IV (1928–42), successively.

We have no adequate data for changes in factor proportions.[2] Let us assume for purposes of illustration that each period corresponds to the factor proportion stage of Table III in such way that period 0 was stage $A$, periods I and II were stage $B$ and periods III and IV were stage $C$.

According to our model, taking the allocation weights for agriculture and the factor proportions as given above, we can calculate the factor allocation and output of the three types of goods in each period (see Table IV). Although Table IV represents only one of the possible factor allocations for each period, it is a fairly close approximation of the actual economic development of Japan.

(1) Let us assume that during period I (1878–1902), the labour allocation weight for agriculture, $x$, declined from 1 in period 0 to $\frac{7}{8}$ in period I, but the factor proportion increased from $150C/900L$ to $250C/900L$ and the production set was shifted from $[A_\alpha]$ to $[B_\beta]$. In other words, in this period the Japanese economy utilised its capital accumulation mainly to improve the efficiency of agriculture, and refrained from expanding manufacturing industry ($y$ and $z$ being $\frac{1}{8}$ and 0 respectively). It could, therefore, experience strong accumulation and harmonious development in period I.

(2) Next we shall suppose that in the transition from period I to period II (1903–12), while the factor proportion remained unchanged, $x$ decreased from $\frac{7}{8}$ to $\frac{5}{8}$ and $y$ increased rapidly from $\frac{1}{8}$ to $\frac{1}{3}$. As a result, the output ratio of $X$- and $Y$-goods increased from 541 : 92 = 1 : 0·17 to 383 : 212 = 1 : 0·55. This rapid structural change for developing light industry resulted in weak accumulation [3] and forced the production set to shift back from $[B_\beta]$ to $[B_\alpha]$.

[1] Cf. Kazushi Ohkawa in association with M. Shinohara, M. Umemura, M. Ito and T. Noda, *The Growth Rate of the Japanese Economy since 1878* (Kinokuniya, Tokyo, 1957), p. 28, Table 11.

[2] Changes in factor proportions are well reflected in changes in the factor price ratio. The factor price ratio of Japan is examined by Gustav Ranis, "Factor Proportions in Japanese Economic Development," *American Economic Review*, September 1957, p. 597.

[3] Because of an assumption that the factor proportion remained unchanged in the transition period, capital shortage in the structural change is a little exaggerated. Actually the capital/labour proportion increased by capital accumulation and foreign capital flowed in even in the transition period.

TABLE IV

*Supposed Factor Allocations and Outputs in Japan*

| (1) Period. | (2) Production set chosen. | (3) * Allocation of capital. | (4) Output. |
|---|---|---|---|
| 0 | $[A_\alpha]$ | $X_1$ $150 \times 1{\cdot}0 = 150$<br>Total capital 150 | $P_X$ $575 \times 1{\cdot}0 = 575$ |
| I | $[B_\beta]$ | $X_2$ $200 \times \frac{7}{8} = 175$<br>$Y_2$ $600 \times \frac{1}{8} = 75$<br>Total capital 250 | $P_X$ $618 \times \frac{7}{8} = 541$<br>$P_Y$ $735 \times \frac{1}{8} = 92$ |
| II | $[B_\alpha]$ | $X_1$ $150 \times \frac{2}{3} = 100$<br>$Y_1$ $450 \times \frac{1}{3} = 150$<br>Total capital 250 | $P_X$ $575 \times \frac{2}{3} = 383$<br>$P_Y$ $636 \times \frac{1}{3} = 212$ |
| III | $[C_\beta]$ | $X_2$ $200 \times \frac{3}{5} = 120$<br>$Y_2$ $600 \times \frac{11}{30} = 220$<br>$Z_2$ $1{,}800 \times \frac{1}{30} = 60$<br>Total capital 400 | $P_X$ $618 \times \frac{3}{5} = 371$<br>$P_Y$ $735 \times \frac{11}{30} = 270$<br>$P_Z$ $1{,}510 \times \frac{1}{30} = 50$ |
| IV | $[C_\alpha]$ | $X_1$ $150 \times \frac{1}{2} = 75$<br>$Y_1$ $450 \times \frac{7}{18} = 175$<br>$Z_1$ $1{,}350 \times \frac{1}{9} = 150$<br>Total capital 400 | $P_X$ $575 \times \frac{1}{2} = 288$<br>$P_Y$ $636 \times \frac{7}{18} = 247$<br>$P_Z$ $1{,}220 \times \frac{1}{9} = 136$ |
| $n$ | $[D_\beta]$ | $X_2$ $200 \times \frac{1}{2} = 100$<br>$Y_2$ $600 \times \frac{1}{3} = 200$<br>$Z_2$ $1{,}800 \times \frac{1}{6} = 300$<br>Total capital 600 | $P_X$ $618 \times \frac{1}{2} = 309$<br>$P_Y$ $735 \times \frac{1}{3} = 245$<br>$P_Z$ $1{,}510 \times \frac{1}{6} = 252$ |

* The allocation of labour is easily found if total labour, 900, is multiplied by allocation weights, $x$, $y$ and $z$, shown in this column.

Period II was the first difficult decade of structural change of the Japanese economy.

(3) During period III (1913–27), it is supposed, as in the case of period I, the labour allocation weight for agriculture, $x$, declined further from $\frac{2}{3}$ in period II to $\frac{3}{5}$ in period III, but the factor proportion increased from $250C/900L$ to $400C/900L$, and the production set was shifted from $[B_\alpha]$ to $[C_\beta]$. The Japanese economy utilised its capital accumulation during this time mainly to improve the efficiency of agriculture and light industry, the latter of which was not so capital intensive as heavy industry but was fairly labour absorptive. The success in maintaining strong accumulation and harmonious development in this period was due to the fact that heavy industry was not expanded (the ratio of labour allocation weights for heavy- and light-industry, $z/y$, being only $\frac{1}{30} : \frac{11}{30} = \frac{1}{11}$).

(4) In the transition from period III to period IV (1928–42), it is supposed, while the factor proportion remained unchanged, $x$ decreased from $\frac{3}{5}$ to $\frac{1}{2}$ and $z/y$ increased rapidly from $\frac{1}{11}$ to $\frac{7}{18}$ $(= \frac{1}{9} : \frac{7}{18})$. As a result, the output ratio of $X$-, $Y$- and $Z$-goods changed from $371 : 270 : 50 = 1 : 0{\cdot}73 : 0{\cdot}14$

in period III to 288 : 247 : 136 = 1 : 0·86 : 0·47 in period IV. Thus, the output of *Y*- and *Z*-goods increased relative to *X*-goods and, moreover, *Z*-goods greatly increased relative to *Y*-goods. This rapid growth of heavy industry resulted again in weak accumulation and forced the production set to shift back from $[C_\beta]$ to $[C_\alpha]$. The period of the 1930s was the second difficult decade of structural change in the Japanese economy.

(5) It is hoped that the Japanese economy will reach $[D_\beta]$ in Table IV, where $x$ is $\frac{1}{2}$, $z/y$ is $\frac{1}{2}$ (the output ratio of *Y*- and *Z*-goods being 245 : 252), in the post-war period or in the near future.

Our analysis is confined to a historical explanation of the course of industrialisation in Japan.[1] The relationship between the historical development and the welfare optimum is not explicitly studied in this paper. To investigate this relationship, the growth of and structural changes in demand at home as well as abroad must be introduced into our model. In our model, however, it is implicitly assumed that the effects of changes in demand conditions are wholly reflected in changes in relative prices of goods. Given prevailing long-run price trends, production functions are selected and factors are allocated in such a way that factor prices are determined by their marginal productivity and product prices are equal to the total of factor prices. In this sense, the optimum welfare is attained.

Japanese experience in industrialisation suggests the following. First, the diversification of production was necessary mainly for two reasons. The decreases in foreign demand for our traditional exports turned the terms of trade against us. Also when certain specialised lines of production increased beyond a given scale, decreasing returns to resources used intensively in that industry occurred. Thus, the traditional line became unprofitable and it became necessary to develop new industries for which the world demand was expected to grow.

Secondly, to transfer resources from the declining to the growing industries and to reach the welfare optimum required a fairly long period of adjustments. The period of structural changes for diversification was the adjustment period, during which divergences from the optimum welfare developed. Only through rationalisation was the optimum welfare attained. The economy, however, could not remain in one rationalisation course, but had to undergo another structural change followed by a second rationalisation course. " Creative destructions " in the Schumpeterian sense recurred in our economic development.

The rationalisation of limited lines of production stimulates international specialisation in so far as lines of the comparative advantage of a country over the rest of the world do not change. Actually the comparative advantage and the world price structure change over time due to the see-saw of economic development among nations and, therefore, a country must diversify even

[1] The following portions of this section and the next section are revised following the suggestions of Sir Roy Harrod.

under the *laissez-faire* system. No one can be certain, however, that the path of advance that would be chosen under *laissez-faire* would produce optimum growth, unless one is blessed with perfect foresight.

Thirdly, since our economic development and the choice of courses have been guided mainly by the growth of demand and by changes in the world price structure, our economy has been operating under a *laissez-faire* system and did not develop a system of authoritarian controls over the allocation of resources. To encourage diversification, however, protection for new industries in the form of tariffs and subsidies was provided, as justified by the infant-industry argument. Also public utilities and other social overhead investment were provided for during the period of structural changes by the government, both directly or indirectly.

## V. The Importance of Factor Price Differentials

Are there ways of lessening the difficulties of carrying out structural change? It is certain that foreign investment and the foreign-exchange reserves which the economy has accumulated prior to the structural change play a critical and strategic role. They cover the increase of capital-goods imports and help to bring about a change in the capital–labour ratio of the economy as occurred in the case of Japan.[1]

Besides foreign investment, deliberate factor-price differentials among industries also played an important role in fostering rapid structural changes in Japan. The effect of factor-price differentials can be evaluated from two points of view: First, whether or not they promote the expansion of certain designated industry, and, secondly, whether or not they make the cost of the goods of that industry lower and the international competitive power of that industry stronger than would be the case if free competition prevailed in factor markets and no factor-price differentials existed.

Let us examine, for example, the factor proportion of stage $B$ ($250C : 900L$). Assume that only two goods, $X$ and $Y$, are produced.[2] In our model, different factor-price ratios result in different production methods in each industry and lead to different costs (= prices) of goods. If no factor-price differentials exist, the production set $[B_\beta]$ or $[B_\alpha]$ can be chosen, as shown in Table V. In $[B_\beta]$ the relative cost of $Y$ is lower than in $[B_\alpha]$, but $Y$-industry cannot expand to a big scale, since $y$ will be only $\frac{1}{3}$. Conversely, in $[B_\alpha]$, $Y$-industry can expand to a big scale ($y = \frac{1}{2}$), but its relative cost will be higher than in $[B_\beta]$. Factor-price differentials may create a room for both expanding $Y$-industry to a larger size than in $[B_\beta]$ and reducing its relative cost lower than in $[B_\alpha]$. Now, there are two ways of determining

[1] The role played by foreign investment in Japanese economic development is thoroughly investigated by Edwin P. Reubens, "Foreign Capital and Domestic Development in Japan," *Economic Growth: Brazil, India, Japan*, ed. by S. Kuznets, W. E. Moore and J. J. Spengler (Durham, N.C.), 1955.

[2] A similar examination can be made in the more complicated case of three products. The effects of factor-price differentials are in principle the same as the case of two products.

factor-price differentials. The first way, which is shown in Table V as $[B_{\beta'}]$, is to let $Y$-industry, the industry which the economy intends to expand, choose its production method, $Y_1$, from the less rationalised set $\alpha$, and let $X$-industry choose its method, $X_2$, from the relatively more rationalised set $\beta$.[1] Conversely, the second way, as shown by $[B_{\alpha'}]$, is to let $Y$-industry choose its production method, $Y_2$, from a more rationalised production set relative to $X$-industry, $X_1$. Then the allocation of factors necessary for full employment both of capital and labour will determine the labour allocation weight for $Y$-industry, as shown in column (2) of Table V. Then, it is clear, $[B_{\beta'}]$ makes the expansion of $Y$-industry larger than $[B_\beta]$, and $[B_{\alpha'}]$ makes it much larger than $[B_{\beta'}]$. Hence, in order to expand a more capital-intensive industry relative to other industries, it is better to determine factor-price differentials in such way as to let that industry choose its production method from a more rationalised production set relative to other industries.

TABLE V

*Effects of Factor-price Differentials in Factor Proportion Stage B (250C : 900L)*

| (1) Combination of production method. | (2) Factor allocation weight for $Y$-industry. | (3) * Price of $X$-goods. | | (4) * Price of $Y$-goods. | | (5) Price ratio of $X$- and $Y$-goods. | |
|---|---|---|---|---|---|---|---|
| | | $\pi_x$ | $\pi_{x'}$ | $\pi_y$ | $\pi_{y'}$ | $\pi_x : \pi_y$ | $\pi_{x'} : \pi_{y'}$ |
| $[B_\beta]$ $(X_2, Y_2)$ | $y_2 = \frac{1}{4}$ or 0·125 | 1·942 | 1·294 | 2·449 | 1·633 | 1 : 1·261 | 1 : 1·261 |
| $[B_{\beta'}]$ $(X_2, Y_1)$ | $y_1 = \frac{1}{5}$ or 0·200 | 1·942 | 1·294 | 2·830 | 1·415 | 1 : 1·457 | 1 : 1·093 |
| $[B_{\alpha'}]$ $(X_1, Y_2)$ | $y_2 = \frac{2}{9}$ or 0·222 | 2·087 | 1·043 | 2·449 | 1·633 | 1 : 1·173 | 1 : 1·565 |
| $[B_\alpha]$ $(X_1, Y_1)$ | $y_1 = \frac{1}{3}$ or 0·333 | 2·087 | 1·043 | 2·830 | 1·415 | 1 : 1·356 | 1 : 1·356 |

* See, column (4) of Table I.

Factor-price differentials are also effective in making the cost (= price) of certain goods cheaper. This is important for a less-advanced country which wishes to develop certain manufacturing industry successfully under keen international competition. The cost (= price) of $X$- and $Y$-goods for different combinations of production methods are calculated in columns (3) and (4) of Table V, where $\pi$ represents the cost in terms of labour and, therefore, price ratio $\pi_x : \pi_y$ involves no wage differentials but only profit-rate differentials for the case $[B_{\beta'}]$ and $[B_{\alpha'}]$ while $\pi'$ represents the cost in terms of capital and, therefore, price ratio $\pi_{x'} : \pi_{y'}$ involves wage differentials but no profit-rate differentials.

Looking at the cost ratio of $X$- and $Y$-goods in column (5) of Table V, it is easily seen that the relative cost of $Y$-goods whose output expansion is desired is lowest for $\pi_{x'} : \pi_{y'}$ of $[B_{\beta'}]$. This is, however, highly paradoxical and cannot be recommended, since $Y$-industry, to which labour should be

[1] It ought to be remembered that production methods $X_1$ and $Y_1$ belong to production set $\alpha$ (Table II) and their factor-price ratio is $f_L : f_C = 1 : 2$, while $X_2$ and $Y_2$ belong to set $\beta$ and their factor-price ratio is $f_L : f_C = 1 : 1{\cdot}5$.

attracted, must offer a lower wage than other industries, out of which labour has to be drawn.

The relative cost of $Y$-goods is second lowest for $\pi_x : \pi_y$ of $[B_{\alpha'}]$, which is lower than that of $[B_\beta]$ and much lower than that of $[B_\alpha]$. No wage differentials are involved in $[B_{\alpha'}]$, but $Y$-industry can offer a higher wage within a certain margin than other industries in so far as the relative cost of $Y$ in $[B_{\alpha'}]$ is lower than the world price ratio. A difficulty remains since the price of capital should be lower in $Y$-industry, whose expansion in output is desired. It depends on the behaviour of the capitalists whether or not they will shift capital from the more-profitable to the less-profitable industries. It may be necessary, as it was often the case in Japan, for the Government to extend loans at low interest and/or to provide subsidies to the capital-intensive $Y$-industry in order to foster structural changes.

It follows that, in order to expand a more capital-intensive industry and to make its costs cheaper relative to other industries, it would be effective to determine factor-price differentials in such way as to let that industry choose its production method from a more rationalised production set and to let the price of capital (the factor used more intensively in that industry) be cheaper than in other industries.

In this paper, constant returns to scale for each industry was assumed. If the expansion of output in capital-intensive $Y$-industry induces economies of scale and/or technological progress [1] in that industry, difficulties in structural changes are mitigated; the capital-intensive $Y$-industry can expand much more than indicated above, and its relative cost will be much lower even if it offers higher rewards both to labour and capital than other industries.

## VI. Summary

An attempt has been made to build a model which shows that the course of economic development changes according to the economy's choice either of diversification of industry or of rationalisation of industry as the capital–labour ratio increases for the economy as a whole. The Japanese economy chose first the diversification course and then the rationalisation course, and accomplished a rapid development. It has also been suggested that factor-price differentials among industries are helpful, as in the case of the Japanese economic development, in transferring resources during periods of structural change and in making stronger the international competitive power of the industries which are intended for expansion. It is believed that a further study, both of the model and of optimum factor-price differentials, is worth pursuing for the economic development of under-developed countries.

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[1] The effects of technological progress are clarified by R. Findlay and H. Grubert, "Factor Intensity, Technological Progress, and the Terms of Trade," *Oxford Economic Papers*, New Series Vol. 11, No. 1, February 1959, pp. 111–21.

# PROPORTIONS OF EXCHANGE [1]

*The price of every good is accompanied by an invisible inscription for the buyer:*

*"Just try to produce this good cheaper."*

BEFORE the days of money the goods were exchanged for goods. Thus an analysis of prices is really an analysis of ratios of exchange of goods. Prediction of the prices, for a free market, or their fixing, for a planned economy, are of a great importance, because the actions of buyers, as well as of sellers, and the activity of the variant branches of industry and agriculture, and of whole countries depend on the level of prices.

The simplest way in which many authors have tried to analyse the relations of exchange is by analysis of the case when there are only two partners in the market who have no previous experience of exchange. In other words, they have analysed the so-called " first step," the first act of exchange when the partners must work out the ratio of exchange for themselves. (One may suppose that such cases really did take place in the beginning of civilisation.)

This work is not an exception. Its contents may be divided into the following parts:

(1) analysis of the equality of the partners;
(2) the formula of exchange;
(3) analysis of the formula of exchange;
(4) a brief historical reference;
(5) supplement.

## I. APPRAISEMENT OF GOODS BY MEANS OF OWN LABOUR

It is necessary to postulate the following by way of preliminary: every partner produces not only the goods he offers for exchange, but he produces the goods he wishes to acquire also. In fact, as we know, before the beginning of trade every economy was " natural " and it independently produced every product required—apart from some things which might be obtained from subjugate countries as a tribute. Hence, every partner takes part in

[1] The following submission, coming from the Soviet Union, has been accepted, although it appears to be deficient in knowledge of the further developments of the theory of international interchange that have sprung from the work of the classical authors whom it cites. But whereas this later work, following J. S. Mill, has traced out what may be expected to happen in consequence of the balance between supply and demand, and, subject to important reservations, has held that the terms and flow of trade that occur, when supply and demand are in equilibrium, should secure the maximum gain for the two partners to the trade taken together, Dr. Shaynin, starting from the same basic assumptions, viz., inequality in the comparative productive capacities of two countries, has analysed the course that trade should take according to the criterion of *equality* of net gain, in some sense, for the two partners. [Ed.]

the exchange not to acquire something that he cannot produce by himself, but to receive this something for a smaller quantity of his own labour.

This thesis allows one to understand how the partners appraise each other's goods. Let two natural economies take the path of exchange. Each economy produces wheat and meat, but the first economy offers to give wheat in exchange, and the second one offers meat. Let us name the first economy the Farmer's economy, and the second one the Hunter's economy. Let us suppose that the Farmer requires 2 days of labour for the production of a bushel of wheat and 4 days for the production of a centner of meat. Let us suppose that the Hunter requires 6 days of labour for the production of a bushel of wheat and 1 day for the production of a centner of meat. Here is the corresponding table:

TABLE I

| Name of economy. | Productivity of daily labour. | |
|---|---|---|
| | Production of wheat, bushels. | Production of meat, centners. |
| 1. Farmer | $\frac{1}{2}$ | $\frac{1}{4}$ |
| 2. Hunter | $\frac{1}{6}$ | $1$ |
| The mean productivity | $\frac{4}{12}$ | $\frac{5}{8}$ |

The Farmer has an advantage over the Hunter in wheat production, and the Hunter has an advantage over the Farmer in meat production. This may result from the following differences between the partners:

(1) geographical conditions;
(2) material structures of the means of production;
(3) personal features of the producers.

As will be shown below, the causes of differences between the partners regarding the proportions of exchange are a matter of indifference.

*The Extremal Values of Equivalents of 1 Bushel of Wheat and of 1 Centner of Meat*

Let us suppose that the Farmer offers for exchange 1 bushel of wheat. What equivalent may satisfy him?

1 bushel of wheat takes the Farmer 2 days of his labour. For this time he may produce $\frac{1}{2}$ centner of meat. Hence, he will agree to receive for 1 bushel of wheat any quantity of meat more than $\frac{1}{2}$ centner of meat. On the other hand, 1 bushel of wheat takes the Hunter 6 days of labour. For this time he may produce 6 centners of meat. Hence, he may offer for a bushel of wheat any quantity of meat less than 6 centners. This dependence may be expressed by means of inequalities:

$$\frac{1}{2} < X < 6 \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where $X$ (centners of meat) is an equivalent of 1 bushel of wheat. Similarly, one may demonstrate that the equivalent of 1 centner of meat must be more

than $\frac{1}{8}$ and less than 2 bushels of wheat. This may be also expressed by means of inequalities:

$$\frac{1}{8} < Y < 2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where $Y$ (bushels of wheat) is an equivalent of 1 centner of meat $\left(Y = \frac{1}{X}\right)$.

*Analysis of Relations of the Partners when an Exchange Occurs According to the Formula: "I Give You a Product of my daily Labour and You Give Me a Product of your daily Labour in Exchange."*

Let us analyse any case of exchange subject to (1). Let us analyse the following proportion of exchange:

$$1 \text{ bushel of wheat} = 2 \text{ centners of meat} \quad . \quad . \quad . \quad (3)$$

*i.e.*, a case, when each of the partners gives the other the product of 2 days of his labour. What is a result of this exchange?

The Farmer gives 1 bushel of wheat, *i.e.*, a product of 2 days of his labour. For this time he could produce $\frac{1}{2}$ centner of meat. He receives in exchange 2 centners of meat. Hence his net gain is:

$$2 - \tfrac{1}{2} = 1{\cdot}5 \text{ centners of meat}$$

This gain may be also expressed in days of his labour:

$$1{\cdot}5 : \tfrac{1}{4} = 6 \text{ days}$$

This gain may also be expressed in bushels of wheat:

$$\tfrac{1}{2} \text{ bushel} \times 6 = 3 \text{ bushels}$$

The Hunter gives 2 centners of meat, *i.e.*, also a product of 2 days of his labour. For this time he could produce $\frac{1}{4}$ bushel of wheat. He receives in exchange 1 bushel of wheat. Hence his net gain is:

$$1 - \tfrac{1}{4} = \tfrac{3}{4} \text{ bushel}$$

This gain may be expressed in days of his labour:

$$\tfrac{3}{4} : \tfrac{1}{8} = 4 \text{ days}$$

This gain may be also expressed in centners of meat:

$$1 \text{ centner} \times 4 = 4 \text{ centners}$$

Thus the results of exchange are profitable for both of the partners, although the gains *are not equal*. If the gain is appraised in wheat, then the Farmer's gain (3 bushels) is more than the Hunter's ($\frac{3}{4}$ bushel). If the gain is appraised in meat, then the Hunter's gain is more than the Farmer's (4 centners against $1\frac{1}{2}$ centners). If the gain is appraised in days of labour, then the Farmer's gain, 6 days, is more than the Hunter's, 4 days.

Hence, an exchange made according to the formula stated at the title of this section does not secure an equality of gain for the partners. It is necessary to note this because according to "common sense" the equality takes

place only in the case when each of the partners gives the other one a product of the same time of labour. In particular, such an interpretation of equality was defended by P. J. Proudhon in his *Système des contradictions économiques ou philosophie de la misére* and by an American author Carey in his *Manual of Social Science.*

*How It Is Necessary to Understand Equality*

The partners are equal in the relation of exchange. From where does this equality derive? Apparently this equality is based on the ground that each of the partners may give his partner no chance of receiving any gain by means of refusing the exchange. As experience shows, such an equality of a negative criterion leads to a situation, when the gain resulting from the exchange is divided in two (the principle " fifty-fifty ").

It is sufficient to note here that the equality of exchange does not mean that an equal quantity of labour time is contained in the exchanged goods, but it means that as a result of exchange both of the partners receive an *equal gain.* Thus, the results of exchange (not something contained in the goods themselves!) allow both goods to be placed on the same footing.

*The Indices of Gain*

As was explained above, the partners' gain may be expressed in wheat, in meat or in days of labour. According to the conditions of Table I, an equality in wheat does not secure an equality in meat or an equality in days of labour, and vice versa. In fact, if the partners receive the same gain in wheat their gain in days of labour cannot be the same, because their productivity in wheat production is different.

Thus the material indices of gain may show a discrepant picture of mutual gains of the partners. But the index of gain in days of labour is free from this contradiction because this index is of a more general order than the material indices. The index of gain in days of labour is more universal as compared with the material indices. So this is the index that must be used for comparison of the gains of the partners.

*Two Main Cases of Exchange*

Two main cases of exchange may take place:

(1) Each of the partners knows the amount of gain that the other receives as a result of exchange (the case of Conscious exchange).

(2) The partners do not know the amount of this gain (the case of Unconscious exchange).

The strict historical approach would demand the case of Unconscious exchange to be analysed before the Conscious one. But according to our methodical point of view, the case of Conscious exchange is to be analysed before the case of Unconscious exchange, because the last may be reduced to the first.

## II. Formula of Exchange—Arithmetical Example

Let us suppose that equality between the partners takes place if $X$ centners of meat are exchanged for $Y$ bushels of wheat. It is necessary to determine the ratio of $X$ to $Y$.

The Farmer receives $X$ centners of meat, *i.e.*, a product of $X : \frac{1}{4}$ days of his labour. He gives the Hunter $Y$ bushels of wheat, *i.e.*, $Y : \frac{1}{8}$ days of his labour. His net gain is:

$$X : \tfrac{1}{4} - Y : \tfrac{1}{8} \text{ days of labour} \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Similarly, one may demonstrate that the net gain of the Hunter is:

$$Y : \tfrac{1}{8} - X : 1 \text{ days of labour}$$

According to conditions of the problem,

$$X : \tfrac{1}{4} - Y : \tfrac{1}{8} = Y : \tfrac{1}{8} - X : 1 \quad . \quad . \quad . \quad . \quad . \quad (5)$$

Hence $X = \frac{3}{8}Y$, and $Y = \frac{8}{3}X$. $X/Y = \frac{3}{8}$, and $Y/X = \frac{8}{3}$. Thus 5 bushels of wheat, for instance, are equivalent to 8 centners of meat, or 1 centner of meat is equivalent to $\frac{5}{8}$ bushel of wheat.

$$1 \text{ bushel} = \tfrac{3}{8} \text{ centners} \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

$$1 \text{ centner} = \tfrac{5}{8} \text{ bushel} \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

*The General Formula of Exchange*

Let us suppose that productivities of labour of the Farmer and of the Hunter are as follows:

Table II

| Name of economy. | Productivity of daily labour. | |
|---|---|---|
| | Wheat production, bushels. | Meat production, centners. |
| 1. Farmer . . . . . | $M$ | $P$ |
| 2. Hunter . . . . . | $N$ | $K$ |

Let us suppose that the equivalent of 1 bushel of wheat is $X$ centners of meat. If the Farmer gives the Hunter 1 bushel of wheat and received in exchange $X$ centners of meat, then his net gain in days of his labour is equal to:

$$X : P - 1 : M$$

Similarly, the net gain of the Hunter in this case expressed in days of his labour is equal to:

$$1 : N - X : K$$

According to conditions of the problem

$$X : P - 1 : M = 1 : N - X : K \quad . \quad . \quad . \quad . \quad (8)$$

Hence $$X = \frac{PK(M+N)}{MN(P+K)} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (8a)$$

or $$X = \frac{PK}{P+K} \times \frac{M+N}{MN} \quad . \quad . \quad . \quad . \quad . \quad (9)$$

This is the required formula for the exchange of 1 bushel of wheat (here one does not pay attention to the problem of the *quantity* of exchanged product; it may be both more and less than 1 bushel, but the proportion of exchange between wheat and meat will remain constant).

## III. Analysis of the Formula of Exchange

The greater is the fraction, $\frac{PK}{P+K} \times \frac{M+N}{MN}$, the greater is the equivalent of every bushel of wheat. Let us analyse this fraction as to its increase. The fraction increases if $P$ and $K$ (*i.e.*, the partners' productivity in meat production) $\longrightarrow \infty$, and $M$ and $N$ (*i.e.*, the partners' productivity in wheat production) $\longrightarrow 0$.

It seems that the Farmer's interest demands $P$ and $K$ to be as great as possible and $M$ and $N$ to be as small as possible. But the conclusion about the Farmer's interest in a low $M$, *i.e.*, in a low productivity in his wheat production, is not correct.

Diminution of $M$ makes the proportion of exchange more profitable for every bushel of wheat, but the same diminution leads to a reduction in the quantity of bushels. So one may compare the Farmer's gain resulting from an improvement in the ratio of exchange, for every bushel of wheat, with his loss resulting from the diminution of his productivity in wheat production.

Let us suppose that the productivity of the Farmer's labour in wheat production diminishes from $M$ to $M'$ ($M' < M$). The ratio of exchange in this case improves for every bushel of wheat and its equivalent makes $\frac{PK}{P+K} \times \frac{M'+N}{M'N}$ centners of meat. Comparing this equivalent with the former expression, when productivity of the Farmer's labour was $M$ bushels per day, one may note that the Farmer's additional gain resulting from improvement of the ratio of exchange is equal to:

$$\frac{PK}{P+K} \times \frac{M'+N}{M'N} - \frac{PK}{P+K} \times \frac{M+N}{MN} \cdots \frac{PK}{P+K}\left(\frac{1}{M'} - \frac{1}{M}\right)$$

centners of meat for every bushel of wheat exchanged. This additional gain may be expressed in his days of labour:

$$\frac{PK}{P+K}\left(\frac{1}{M'} - \frac{1}{M}\right) : P = \frac{K}{P+K}\left(\frac{1}{M'} - \frac{1}{M}\right)$$

On the other hand, the diminution of productivity of the Farmer's labour in wheat production increases the labour time that is necessary to produce

1 bushel of wheat. Formerly 1 bushel of wheat took the Farmer $1/M$ days of his labour. Now it takes him $1/M'$ days of his labour. The Farmer's loss because of the diminution of his labour productivity is equal to $(1/M' - 1/M)$ days of his labour for every bushel of wheat produced. One may compare the Farmer's loss with the additional gain resulting from the same cause—diminution of Farmer's productivity in wheat production from $M$ to $M'$ bushels per day:

$$\frac{1}{M'} - \frac{1}{M} \text{ and } \frac{K}{K+P}\left(\frac{1}{M'} - \frac{1}{M}\right)$$

The second expression differs from the first one by the coefficient $\frac{K}{K+P}$. This coefficient is less than 1, as $K < K + P$. Hence the second expression is less than the first one, *i.e.*, the Farmer's loss from diminution of his productivity of labour is more than his additional gain from the improvement in the ratio of exchange. Thus the Farmer has no interest in diminishing his productivity of labour in his market branch, wheat production.[1]

Similarly, one may demonstrate that the Hunter has an interest in increasing (not diminishing) his labour productivity in his own market branch, meat production.

Generalising all that is stated above, one may formulate the following rule: The partners have a mutual interest in increasing the productivity of labour in their market branches, but each partner has an interest in increasing that of his own consumers' branch and has an interest in his partner diminishing that is his consumers' branch.

Formula of exchange (9) shows us that the ratios of exchange are *fully relative*. They depend on the productivity of labour of every partner not only in the market branches but also in the consumers' branches to the same extent.

*The Problem of the Primary Development of either Market or Consumers' Branch*

Let us suppose that one of the partners has an equal opportunity to increase his labour productivity in market goods production and in consumers' goods production. Let us suppose that the Farmer may double his labour productivity both in wheat and in meat production. What variant is more advantageous for him?

Let us suppose the Farmer to produce, instead of $M$ bushels, $2M$ bushels per day. This gives him a gain of 1 day for every day of his labour. But this gain diminishes, since the ratio of exchange for every bushel of wheat (according to equation (9)) becomes worse. It is sufficient to note here that the Farmer's double productivity in wheat production brings him *less*

[1] One may demonstrate, that by the diminution of his labour productivity from $M$ to $M'$ bushels of wheat per day, the Farmer receives less quantity of meat from the Hunter in exchange for all his wheat that he may produce per day according to his new productive capacity. This is another way of demonstrating that the Farmer has no interest in diminishing labour productivity in wheat production.

than double gain. Now let us suppose that the Farmer produces, instead of $P$ centners of meat, $2P$ centners of meat per day. This also makes his gain 1 day for every day of his work. But this gain is increased even more, since the ratio of exchange for 1 bushel of wheat, according to equation (9), must improve. Suffice it to say here that the Farmer's double productivity in meat production brings him *more* than a double gain.

One may make the following conclusion: the increase of labour productivity in consumers' goods production, other things being equal, is more profitable for every partner than the same increase in market goods production.[1]

*The Problem of Conversion of Consumers' Branch into Market Branch (Formula of the Net Gain of Every Partner Resulting from Exchange)*

According to equation (8), the Farmer's net gain, expressed in days of his labour is equal to $X : P - I : M$. The value of $X$ is known from equation (9). Let us substitute the value of $X$ in this expression:

$$X : P - 1 : M = \frac{PK(M+N)}{MN(P+K)} : P - \frac{1}{M} = \frac{KM - PN}{MN(P+K)}$$

days of labour. This is the Farmer's gain, resulting from exchange, for every bushel of wheat exchanged. Expression $KM - PN$ is positive; otherwise the fraction $\frac{KM - PN}{MN(P+K)}$ would be negative, *i.e.*, the partners, instead of having a gain, would receive a loss. $K$ and $M$ are indices of labour productivity in the market branches, $P$ and $N$ are those in the consumers' branches. Hence the product of the indices of market branches must be more than that of the consumers' branches. This is impossible if the Farmer, having preference over the Hunter in wheat production, offers meat, while the Hunter, having preference over the Farmer in meat production, offers him wheat in exchange. The partners' gain would be negative in this case, it would be " an inside out exchange."

If the Farmer offers wheat for exchange, and the Hunter offers meat for exchange, and if

$$M : N > P : K \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

then the partners receive gain from exchange.

If

$$M : N = P : K \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)$$

then we have a case of equilibrium, when the partners receive from the exchange no gain and no loss.

If

$$M : N < P : K \quad . \quad . \quad . \quad . \quad . \quad . \quad (13)$$

then the exchange in unprofitable.

[1] Instead of the formula of exchange one may analyse the formula of net gain of every partner; this formula is set forth below. The outcome in any case is the same.

It is necessary to keep in mind that these three rules are correct in the case when $M$ and $K$ are indices of productivity of labour in market branches and $P$ and $N$ are those in consumers' branches. $M, N, P, K$ may be constant, while an exchange may be advantageous or not—according to the product offered for exchange by each partner. Incidentally somebody may acquire goods that he produces cheaper than that partner who offers it for exchange. There is an example below, derived from David Ricardo, about this same case of exchange between England and Portugal according to conditions by which Portugal acquires English cloth though it produces cloth cheaper than England.

*The Case of Unconscious Exchange*

As has been demonstrated, proportions of Unconscious exchange must conform to inequalities (1) or (2). Within the limits of these inequalities any proportion of exchange may take place with the same degree of probability. The problem is: is it possible to deduce a formula of exchange from many independent acts of exchange? Is there a tendency that governs all these acts?

*The Aim of Exchange*

Naturally, such a tendency really exists because it tends to take place at every act of exchange. Every partner tries to create the most favourable proportion of exchange for every unit of his goods and to receive a maximum gain from exchange. The gain of every partner may be expressed in days of his labour. So every partner conducts his exchange in such a way as to try to win the maximum number of days of his labour. As the preponderance of one partner at any act of exchange is of the same degree of probability as that of the second, one may expect that the gains of the partners, resulting from many acts of exchange, become equal. It follows from this that all the Farmers (the Joint Farmer) receive the same gain as all the Hunters (the Joint Hunter) do. But this is a condition that really lay in the ground of the Conscious exchange. Hence one may convert the case of Unconscious exchange to the case of Conscious one. Thus the formula of exchange for many acts of Unconscious exchange is to coincide with that of the Conscious one.

## IV. A Brief Historical Reference

Deduction of the formula of exchange is based on two principles: (1) appraisement of the goods by both of the partners by means of their own labour; (2) equality of gains, received from exchange by each partner.[1] These two principles (which may be united in one rule, formulated as follows: " appraisement of goods according to the mutual gain of the partners ") are

[1] Without this conception it is impossible to explain, why slag, scrap, dung and other waste and garbage from production really have a price (to say nothing of natural resources, land, for instance), though no labour was spent for their actual producing.

not original. Adam Smith was the first who pronounced that the real price of a thing does not coincide with the producer's time, but that it is equal to the quantity of labour necessary for the buyer himself if he produces this thing himself. (It is necessary to note, however, that Smith has not mentioned such appraisement to be THE HIGHEST LIMIT of price of goods.) Smith affirmed that a good householder must not acquire anything that he may produce cheaper at home. Smith was the first who paid attention to the principle "fifty-fifty," according to which the gain received by the partners from the exchange is divided in two, when he wrote that the normal level of interest for the lent capital had been equal to half of the profit.[1]

Both of these principles were applied by Ricardo when he analysed the case of exchange between England and Portugal. According to Ricardo's conditions, England offers for exchange its cloth, and Portugal offers its wine. For producing some quantity of cloth and wine England needs 100 and 120 man-years of its labour, and Portugal 90 and 80 man-years accordingly.

The way in which Ricardo expressed the problem is distinguished from that in the case of exchange between the Farmer and the Hunter. But the problem about cloth and wine and the problem about wheat and meat are similar, and they are solved by means of the same rule. Ricardo offers such a proportion of exchange:

100 man-years of English labour, expressed in cloth =
80 man-years of Portuguese labour, expressed in wine[2] (14)

But the proportion offered by Ricardo does not secure the exact equality of the partners. In fact, England receives from Portugal wine for production of which 120 man-years of its labour are needed. England gives Portugal the cloth, production of which takes England 100 man-years of its labour. England's net gain is $(120 - 100) = 20$ man-years of its labour. On the other hand, Portugal receives from England cloth, production of which takes Portugal 90 man-years of its labour and gives in exchange the wine, production of which takes it 80 man-years of its labour. Portugal's net gain is $(90 - 80) = 10$ man-years of its labour, *i.e.*, less than England's.

Equality between England and Portugal would take place if the proportion of exchange was the following:

$105\frac{5}{9}$ man-years of English labour, expressed in cloth =
80 man-years of Portuguese labour, expressed in wine (15)

In fact, in this case England receives a quantity of wine, the production of which takes it 120 man-years. Its net gain is $(120 - 105\frac{5}{9}) = 14\frac{4}{9}$ man-years of its labour. On the other hand, Portugal receives a quantity of English cloth, the production of which takes Portugal $94\frac{4}{9}$ man-years of its labour. (The calculation is made in the following way: according to the

[1] *Wealth of Nations*. The same idea about appraisement of the goods by means of buyer labour was stated by J. C. de Sismondi in his *New Principles of Political Economy*.

[2] *The Principles of Political Economy and Taxation*.

conditions of the problem, the same quantity of cloth that takes England 100 man-years of its labour, takes Portugal 90 man-years. Hence the same quantity of cloth that takes England $105\frac{5}{19}$ man-years of its labour, takes Portugal $94\frac{14}{19}$ man-years of its labour.) The net gain of Portugal is $(94\frac{14}{19} - 80) = 14\frac{14}{19}$ man-years of its labour (Q.E.D.).

The principle of appraisement of another's goods by means of one's own labour was applied by John Stuart Mill. Mill's example concerns the exchange between England and Germany according to the following conditions:

$$10 \text{ yards of cloth} = 15 \text{ yards of linen (in England)} \quad (16)$$

$$10 \text{ yards of cloth} = 20 \text{ yards of linen (in Germany)} \quad (17)$$

Thus Mill's problem is not formulated in the way of Ricardo, nor in the way used in the case of exchange between the Farmer and the Hunter. But it is solved by means of the same rule.

Mill himself has been satisfied with the assertion that any quantity of German linen more than 15 and less than 20 yards may be an equivalent of 10 yards of English cloth.[1]

According to the conditions of Mill's problem, one does not know the time of production of linen and cloth in England nor in Germany. So one cannot define the gain of the partners in the way needed for the formula of exchange.[2]

One may deduce the formula of exchange if it is assumed that production of 10 yards of cloth takes, for instance, the same time of labour both in England and in Germany. In this case the proportion of exchange is such:

$$10 \text{ yards of cloth} = 17\tfrac{1}{2} \text{ yards of linen} \quad . \quad . \quad (18)$$

(Deduction of this formula is omitted.)

In fact, supposing the unit of labour time to be such as is necessary for production of 10 yards of cloth, England receives $17\frac{1}{2} : 15$ units of time of its labour, and gives in exchange 10 yards of cloth, *i.e.*, a unit of time of its labour. Its net gain is $(17\frac{1}{2} : 15 - 1) = \frac{1}{7}$ units of labour time. On the other hand, Germany receives 10 yards of cloth, *i.e.*, a unit of its time of labour, and gives in exchange $17\frac{1}{2}$ yards of linen, *i.e.*, a product of $17\frac{1}{2} : 20$ unit of time of its labour. Germany's net gain is $(1 - 17\frac{1}{2} : 20) = \frac{1}{7}$ unit of time of its labour (Q.E.D.).

To deduce the formula of exchange some other authors in different connections and at different times have used the principles of appraisement of the goods by means of own labour and/or of dividing in two the gain resulting from exchange. (For instance, Henry George, in his *Progress and*

[1] *The Principles of Political Economy*.

[2] The conditions of Mill's problem suggest, however, an idea about another possible interpretation of equality, namely, that equality between two partners consists in the same ratio of net gain of both of the partners, expressed in their time of labour, to the time necessary for production of their market goods. This interpretation of equality is analysed in more detail in the Supplement.

double gain. Now let us suppose that the Farmer produces, instead of $P$ centners of meat, $2P$ centners of meat per day. This also makes his gain 1 day for every day of his work. But this gain is increased even more, since the ratio of exchange for 1 bushel of wheat, according to equation (9), must improve. Suffice it to say here that the Farmer's double productivity in meat production brings him *more* than a double gain.

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**According to equation (8), the Farmer's net gain, expressed in days of his labour is equal to $X : P - I : M$. The value of $X$ is known from equation (9). Let us substitute the value of $X$ in this expression:**

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It is necessary, however, to remark that these three rules are correct in the case when $I$ and $J$ are indices of productivity of labour in market branches and $P$ and $N$ are those in consumers' branches. $M, N, P, K$ may be constant, while an exchange may be advantageous or not—according to the product offered for exchange by each partner. Incidentally somebody may acquire goods that he produces cheaper than that partner who offers it for exchange.

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not original. Adam Smith was the first who pronounced that the real price of a thing does not coincide with the producer's time, but that it is equal to the quantity of labour necessary for the buyer himself if he produces this thing himself. (It is necessary to note, however, that Smith has not mentioned such appraisement to be THE HIGHEST LIMIT of price of goods.) Smith affirmed that a good householder must not acquire anything that he may produce cheaper at home. Smith was the first who paid attention to the principle "fifty-fifty," according to which the gain received by the partners from the exchange is divided in two, when he wrote that the normal level of interest for the lent capital had been equal to half of the profit.[1]

Both of these principles were applied by Ricardo when he analysed the case of exchange between England and Portugal. According to Ricardo's conditions, England offers for exchange its cloth, and Portugal offers its wine. For producing some quantity of cloth and wine England needs 100 and 120 man-years of its labour, and Portugal 90 and 80 man-years accordingly.

The way in which Ricardo expressed the problem is distinguished from that in the case of exchange between the Farmer and the Hunter. But the problem about cloth and wine and the problem about wheat and meat are similar, and they are solved by means of the same rule. Ricardo offers such a proportion of exchange:

100 man-years of English labour, expressed in cloth =
80 man-years of Portuguese labour, expressed in wine[2] (14)

But the proportion offered by Ricardo does not secure the exact equality of the partners. In fact, England receives from Portugal wine for production of which 120 man-years of its labour are needed. England gives Portugal the cloth, production of which takes England 100 man-years of its labour. England's net gain is $(120 - 100) = 20$ man-years of its labour. On the other hand, Portugal receives from England cloth, production of which takes Portugal 90 man-years of its labour and gives in exchange the wine, production of which takes it 80 man-years of its labour. Portugal's net gain is $(90 - 80) = 10$ man-years of its labour, *i.e.*, less than England's.

Equality between England and Portugal would take place if the proportion of exchange was the following:

$105\frac{5}{11}$ man-years of English labour, expressed in cloth =
80 man-years of Portuguese labour, expressed in wine (15)

In fact, in this case England receives a quantity of wine, the production of which takes it 120 man-years. Its net gain is $(120 - 105\frac{5}{11}) = 14\frac{6}{11}$ man-years of its labour. On the other hand, Portugal receives a quantity of English cloth, the production of which takes Portugal $94\frac{6}{11}$ man-years of its labour. (The calculation is made in the following way: according to the

[1] *Wealth of Nations.* The same idea about appraisement of the goods by means of buyer labour was stated by J. C. de Simondi in his *New Principles of Political Economy.*

[2] *The Principles of Political Economy and Taxation.*

conditions of the problem, the same quantity of cloth that takes England 100 man-years of its labour, takes Portugal 90 man-years. Hence the same quantity of cloth that takes England $105\frac{5}{11}$ man-years of its labour, takes Portugal $94\frac{1}{11}$ man-years of its labour.) The net gain of Portugal is $(94\frac{1}{11} - 80) = 14\frac{1}{11}$ man-years of its labour (Q.E.D.).

The principle of appraisement of another's goods by means of one's own labour was applied by John Stuart Mill. Mill's example concerns the exchange between England and Germany according to the following conditions:

$$10 \text{ yards of cloth} = 15 \text{ yards of linen (in England)} \quad (16)$$

$$10 \text{ yards of cloth} = 20 \text{ yards of linen (in Germany)} \quad (17)$$

Thus Mill's problem is not formulated in the way of Ricardo, nor in the way used in the case of exchange between the Farmer and the Hunter. But it is solved by means of the same rule.

Mill himself has been satisfied with the assertion that any quantity of German linen more than 15 and less than 20 yards may be an equivalent of 10 yards of English cloth.[1]

According to the conditions of Mill's problem, one does not know the time of production of linen and cloth in England nor in Germany. So one cannot define the gain of the partners in the way needed for the formula of exchange.[2]

One may deduce the formula of exchange if it is assumed that production of 10 yards of cloth takes, for instance, the same time of labour both in England and in Germany. In this case the proportion of exchange is such:

$$10 \text{ yards of cloth} = 17\tfrac{1}{2} \text{ yards of linen} \quad . \quad . \quad (18)$$

(Deduction of this formula is omitted.)

In fact, supposing the unit of labour time to be such as is necessary for production of 10 yards of cloth, England receives $17\frac{1}{2} : 15$ units of time of its labour, and gives in exchange 10 yards of cloth, *i.e.*, a unit of time of its labour. Its net gain is $(17\frac{1}{2} : 15 - 1) = \frac{1}{2}$ units of labour time. On the other hand, Germany receives 10 yards of cloth, *i.e.*, a unit of its time of labour, and gives in exchange $17\frac{1}{2}$ yards of linen, *i.e.*, a product of $17\frac{1}{2} : 20$ unit of time of its labour. Germany's net gain is $(1 - 17\frac{1}{2} : 20) = \frac{1}{2}$ unit of time of its labour (Q.E.D.).

To deduce the formula of exchange some other authors in different connections and at different times have used the principles of appraisement of the goods by means of own labour and/or of dividing in two the gain resulting from exchange. (For instance, Henry George, in his *Progress and*

[1] *The Principles of Political Economy.*

[2] The conditions of Mill's problem suggest, however, an idea about another possible interpretation of equality, namely, that equality between two partners consists in the same ratio of net gain of both of the partners, expressed in their time of labour, to the time necessary for production of their market goods. This interpretation of equality is analysed in more detail in the Supplement.

*Poverty*, Sismondi and Carey in the above-mentioned works, the authors of the so-called school of the Final Degree of Utility (Karl Menger and others).

The rule about appraisement of goods according to the mutual gain of partners was noticed by the outstanding Russian writer, N. V. Gogol, and it had its reflection in the gambling with " dead souls," when Sobakevitch has appraised his unusual goods (dead serfs, still registered as living) exclusively according to the proposed partner's profit at this operation (" Dead Souls," " Miortviye Dushi ").

The rule about appraisement of goods or services according to the mutual gains of the partners is *openly* used for railroad transport. The tariffs of goods of the same weight and size are different and depend upon the profit received as a result of conveyance by the senders of goods. (See C. Y. Vitte, *The Principles of the Railroad Tariffs*, Russia (1910), *Printzipi Shelesnodoroshnikh Tarifov.*)

*Possible Direction of Further Analysis*

In order to demonstrate the universality of the rule of mutual appraisement of goods according to the partners' gain, it is necessary to complicate the conditions of the simplest case of exchange discussed in this text. It is necessary to analyse the case, when more than two partners take part at exchange and there exists money in the market. Apparently the separate analysis of the case of exchange of instruments and means of production, and of the case of exchange between specialised economies is necessary. But such a work requires a specific investigation.

## V. Supplement

We have analysed two interpretations of equality in this text:

(1) Interpretation of equality in Proudhon's spirit when an exchange is subjected to the following rule: " I give you a product of my labour per day, and you give me a product of your labour per day in exchange." It is an equality of what is given. It was demonstrated that such an interpretation of equality is not correct.

(2) Interpretation of equality as equality of time of labour, gained as a result of exchange. This interpretation of equality has been used throughout the text.

There are at least four other interpretations of equality:

(3) An equality of exchange may be understood as an equality of *what is received.* In this case the formula of exchange may be expressed as follows: " I give you a product of *your* labour per day, and you give me a product of *my* labour per day." According to the condition of Table I, such an equality takes place, when proportion of exchange is:

$$\tfrac{1}{4} \text{ bushel of wheat} = \tfrac{1}{4} \text{ centner of meat}$$

Such an interpretation takes into account, however, the gross receipt of partners, and ignores the main result of exchange.

(4) One may understand an equality of exchange as equality of the ratio between what is received and what is given, expressed in the time of labour of both the partners. According to the conditions of Table I, such an equality takes place when the proportion of exchange is

$$\frac{1}{\sqrt{3}} \text{ bushel of wheat} = 1 \text{ centner of meat} \quad . \quad . \quad (19)$$

(Deduction is omitted. Ratio of what is received to what is given is $2\sqrt{3}$ in this case.)

But such an interpretation of equality is hardly correct, because it ignores the main result of exchange, to the attainment of which the partner's efforts are directed, namely, the net gain.

(5) One may understand an equality as the same ratio of the net gain of each partner to the time of labour, spent on the production of his market goods. Such an interpretation of equality is important if the productivity of one partner's day of labour is not equal to that of another. According to the conditions of Table I, the productivity of the Hunter's day of labour is more efficient than the Farmer's one. In fact, the Farmer excels the Hunter in wheat production by three times ($\frac{1}{2}$ bushel and $\frac{1}{8}$ bushel), while the Hunter excels the Farmer in meat production by four times (1 centner and $\frac{1}{4}$ centner). Such an interpretation of equality leads to a worse ratio of exchange for the Hunter comparatively with equation (9), based on the principle of the same gain for both of the partners, expressed in days of their labour.

In fact, such an interpretation of equality, according to the conditions of Table II, and supposing that $X$ centners of meat are equivalent to 1 bushel of wheat, gives the following equality of exchange:

$$\frac{\frac{I}{N}-\frac{X}{K}}{\frac{X}{K}}=\frac{\frac{X}{P}-\frac{I}{M}}{\frac{I}{M}} \quad . \quad . \quad . \quad . \quad . \quad . \quad (20)$$

The left hand side of this equation is the ratio of the Hunter's net gain to the time of his labour necessary for producing $X$ centners of meat. The right hand side is that of the Farmer to the time of his labour necessary for producing 1 bushel of wheat. Hence

$$X=\sqrt{\frac{PK}{MN}}, \textit{ i.e.}, \text{ 1 bushel} = \sqrt{\frac{PK}{MN}} \text{ centners} \quad . \quad . \quad (21)$$

According to the conditions of Table I, such an interpretation of equality leads to the following proportion of exchange:

$$1 \text{ bushel} \approx 1{\cdot}73 \text{ centners} \quad . \quad . \quad . \quad . \quad (22)$$

as a counterbalance of the proportion

$$1 \text{ bushel} = \tfrac{3}{4} \text{ centners} = 1{\cdot}6 \text{ centners} \quad . \quad . \quad . \quad (6)$$

that results from the main interpretation of equality, adopted in the text. Proportion of exchange: 1 bushel = 1·73 centners (see equation (22)) does not provide the equality of gains. This interpretation of equality means an *inequality* of the gains of the partners, because such an interpretation demands an additional correction allowing for the difference of the partners' productive capacities. In other words, an exchange in the spirit of proportion: 1 bushel = 1·73 centners pretends to equalise not only the gains of the partners, resulting from the exchange, but even the differences between the partners in the sphere of producing.

One may note, however, that such an interpretation of equality is not correct. One man's time gained must be of the same value as another's. In fact, the gain, expressed in time of labour, is of ABSOLUTE importance, because it may be used for many purposes, according to the boundless sphere of human activity, especially as this activity includes not only the productive sphere but also rest and other functions. Inequality in the net gain cannot be justified with the different productivity of labour of the partners, because nobody knows how each partner will spend his time gained.

Even from the point of view of an equality extended to the sphere of producing the different gains of both of the partners, foreseen by the proportion of exchange 1 bushel = 1·73 centners, may not secure this equality, owing to the possible dependence of the differences of the partners' labour productivity on the differences in their *intensity of labour*.

It is possible that an interpretation of equality in the spirit of the proportion of exchange: 1 bushel = 1·73 centners may be given by the specific conditions, when it is known beforehand that every partner will use his gain, expressed in days of labour, in his most productive branch (the Hunter, for instance, will spend it in meat production). So one cannot ignore that in some cases the tendency of exchange, corresponding to the spirit of proportion: 1 bushel = 1·73 centners may actually take place.

(6) It may be considered that one of the variants of Proudhon's interpretation of equality in exchange (based on the idea that the exchanged goods must contain the same quantity of labour time) is such that the exchangeable goods must contain the same quantity of some " mean " time. According to the conditions of Table I, such an interpretation leads to the following proportion of exchange:

$$\tfrac{1}{3} \text{ bushels} = \tfrac{1}{4} \text{ centner} \quad . \quad . \quad . \quad . \quad . \quad . \quad (23)$$

But such interpretation of equality is absolutely artificial, to say nothing of its ignoring the main result of exchange—the gain of the partners.

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# BUSINESS CYCLES—ENDOGENOUS OR STOCHASTIC?[1]

## I. Introduction

The idea that the cyclical fluctuations observed in advanced industrial economies may be due to the effect of erratic, uncorrelated shocks upon an otherwise interrelated system was first suggested by Ragnar Frisch in 1933.[2] This hypothesis received a rather mixed reception. For, on the one hand, an appeal to unexplained random perturbations in order to account for a fundamental feature of the dynamics of a capitalistic economy is not particularly satisfying. This is evidently the position taken by Hicks, who states categorically in discussing Frisch's theory, " this particular hypothesis will not do." [3]

On the other hand, several studies [4] have indicated that Frisch's explanation of cyclical behaviour provides us with an extremely good approximation to the qualitative features of the actual motion of economic time series. One of the most recent of these, and the most detailed, was part of an investigation into the dynamic nature of the Klein–Goldberger econometric model of the United States economy, undertaken in 1956–58 by my husband and myself and published in the October 1959 issue of *Econometrica*.[5] In this paper we found that, in the absence of external perturbations, the time paths of the economic variables of the Klein–Goldberger equations were monotonic and essentially linear in character. Thus, their model does not offer an immediate explanation of an internally generated cyclical process. However, when random shocks of a realistic order of magnitude were superimposed upon the Klein–Goldberger system the cyclical fluctuations which resulted were remarkably similar to those described by the N.B.E.R. as characterising the United States economy. The average duration of a cycle, the mean length of the expansion and contraction phases, and the degree of clustering of individual peaks and troughs around the turning points of the general business cycle all agreed with the corre-

[1] This paper was presented at the December 1959 meeting of the Econometric Society. I am indebted to F. L. Adelman and K. J. Arrow for their valuable suggestions.

[2] R. Frisch, " Propagation and Impulse Problems in Dynamic Economics," *Economic Essays in Honour of Gustav Cassel* (London, 1933), pp. 171–205.

[3] J. R. Hicks, *A Contribution to the Theory of the Trade Cycle* (Oxford, 1950), p. 90. See also, pp. 193–195.

[4] Cf., *e.g.*, R. M. Goodwin, " Econometrics in Business Cycle Analysis," in A. H. Hansen's *Business Cycles and National Income* (New York, 1951), p. 421; E. Slutzky, " The Summation of Random Causes as the Source of the Cyclic Processes," *Econometrica*, Vol. 5 (April 1937), pp. 105–46; M. G. Kendall, *The Advanced Theory of Statistics* (London, 1946), Vol. II, pp. 400–87; and G. H. Fisher, " Some Comments on Stochastic Macro-Economic Models," *American Economic Review*, Vol. 42, June, December 1952, pp. 528–39.

[5] I. Adelman and F. L. Adelman, " The Dynamic Properties of the Klein–Goldberger Model," *Econometrica*, Vol. 27, October 1959, pp. 596–625.

sponding data for the United States. Furthermore, the lead–lag relationships of the endogenous variables included in the model and the indices of conformity of the specific series to the overall business cycle also resembled closely the analogous features of our society. All in all, the shocked Klein–Goldberger model approximated the cyclical behaviour of the United States economy extremely well.

But the fact that the shocked Klein–Goldberger model corresponds so well to economic experience does not prove either that the model itself is a good representation of the fundamental interactions among the several sectors of our economy or that random shocks are the prime cause of business cycles. For the close agreement with reality is, *a priori*, a consequence of both the model and the shocks. How much of this agreement is due to the basic structure of the underlying economic relations, and how much to the stochastic features superimposed upon the model remains to be determined.

This study is designed to shed some light upon this question. We shall proceed in the following way: First of all, in a manner analogous to that used in the previous study, we impose random, uncorrelated shocks upon a set of economic time series related only by accounting definitions, and study the oscillations which result. The degree to which these fluctuations approximate the business cycle observed in the United States economy will then be compared with the corresponding results of our Klein–Goldberger study. We will see that the superposition of shocks upon a model with minimal economic content leads to a reasonable facsimile of a business cycle. However, the approximation will be seen to be distinctly inferior to that derived from the shocked Klein–Goldberger system.

## II. The Naïve Model

The simplest model of an expanding economy that one can generate is to extrapolate all the endogenous variables of the system linearly, having regard only for the accounting identities inherent in the choice of variables. To facilitate comparison with the Klein–Goldberger model, our "naïve" model was derived in the following fashion. All the variables and the accounting identities of the Klein–Goldberger model were retained. However, all the behavioural equations of the system were replaced by simple extrapolations based on least-squares fits to the post-war (1946–52) data. For consumption ($C$), investment ($I$), government expenditures ($G$), corporate savings ($S_P$), corporate profits ($P_C$), indirect taxes less subsidies ($T$), depreciation ($D$), private ($W_1$) and government ($W_2$) employee compensation, the number of wage and salary earners ($N_W$), the index of hourly wages ($w$) and the price index ($p$), simple linear fits were used. Since the short ($i_S$) and long-term ($i_L$) interest rates and the index of hours worked per year ($h$) exhibited no obvious trends during this period, they were taken to be constant. On the other hand, farm income ($A_1$), government payments to farmers ($A_2$) and private ($L_1$) and business ($L_2$) liquid

assets all had declining trends during the sample period. For these quantities it therefore seemed more appropriate to use a fit of the form

$$X = a + \frac{b}{t - \alpha}$$

in order that they never become negative. This procedure yielded a basic set of twenty-five equations in an equal number of variables. Five of these equations are accounting definitions, while the rest express each variable as a function only of time.

In order to see what effects random perturbations may have upon this "naïve" model, a random term $\delta y_t$ was then inserted into those extrapolations which replace *behavioural* equations of the Klein–Goldberger model. For this purpose the value of a variable $y_t$ at time $t$ was defined as its trend value, $\bar{y}_t$, plus a shock term $\delta y_t$. And $y_t$ was assumed to have a Gaussian distribution with a mean of zero. (The resulting system of equations appears in Appendix A2.) In order that the shocks inflicted upon the system be of a realistic order of magnitude at all times, the standard deviation of $\delta y_t$ was evaluated over that portion of the data for which the least-squares fit was made. And, for the subsequent calculations, the ratio of the standard deviation of $\delta y_t$ to $\bar{y}_{t-1}$ was maintained at a value independent of time. It is interesting to note that these standard deviations (see Appendix A3) are, in general, quite small; in fact, only four of them exceed 10% of the trend value of the corresponding variable.

Given the size of the standard deviation, the technique employed to determine the magnitude and sign of the exogenous shock upon each variable was to divide the normal curve of error into 100 regions of equal area. To each region was assigned both the normal deviate associated with the mid-point of its interval and a previously unassigned integer between 00 and 99, inclusive. Then the selection of a two-digit random number effectively specified at random a particular region of the Gaussian distribution and its corresponding normal deviate. Multiplying this deviate by the standard deviation of $\delta y_t$, the magnitude and direction of a shock upon the variable $y$ at time $t$ were established. Since the selection of an interval in this manner was thus purely random, and since all intervals define the same area under the curve, this method produced a normally distributed *random* shock upon the variable in question. The repetition of this procedure for each of the variables of equations (1)–(14) yielded a series of random, normally distributed, uncorrelated shocks of realistic size.

Using this technique for the evaluation of the magnitudes and signs of the random terms, the shocked "naïve" model was solved for 100 years with the aid of an I.B.M. 650 calculator. The typical behaviour of the time series generated by this process is portrayed in Fig. 1. The solid lines in this graph describe the computed time paths of national income, investment and corporate profits, while the dotted lines represent the actual time

Billions of 1939 Dollars
150
125
100
75
50
25
National Income (Scale to left)
Investment (Scale to right)
Corporate profits (Scale to right)
U. S. Actual 1946-52
Time (yrs.)
0
10
20
30
40
50
60
70
80
90
100
450
400
350
300
250
200
150
100
50
Billions of 1939 Dollars

FIG. 1.

paths of the same variables during the post-war period in the United States. As apparent from this figure, under the impact of random shocks the individual variables of the system exhibit cyclical swings of more or less realistic durations and amplitudes.

The presence of qualitatively correct oscillatory movements in the individual variables of this system is but to be expected, however. This much agreement with reality is merely a *necessary* condition of an adequate simulation of the cyclical fluctuations of a real industrial economy. We must investigate further to find out whether or not the shocked version of this "naïve" model really produces business cycles in the technical sense. Specifically, how nearly all-pervasive are the cumulative movements which arise? Are the various oscillations correlated? Is there any consistent phase relationship among the several economic series? Do the time-paths of the individual variables of the model correspond to those observed in the United States economy? To answer these questions, the techniques developed by the N.B.E.R. for the analysis of business cycles were applied to the data.

One property of cyclical fluctuations in an industrial economy is a marked tendency for a clustering of peaks and troughs of individual economic time series about particular reference dates. It is, in fact, precisely this characteristic of business cycles that Burns and Mitchell[1] use as their criterion for the dating of turning-points in the United States economy. And, inasmuch as the oscillations in our model occur in response to random non-correlated perturbations, a study of the simultaneity of occurrence of peaks (and troughs) provides us with quite stringent a test of the realism of this system.

As in the normal N.B.E.R.[2] procedure, the specific cycles were dated first; *i.e.*, all the turning-points of each of the time series were determined. Then, to establish reference dates for the turning-points of the *overall* business cycles, the data were examined for bunching (in time) of specific cycle peaks and troughs. A reference peak (trough) was said to occur in our data during any year in which the modal number of specific cycle peaks occurs, provided that at least 10 peaks (troughs) are found in a 2-year period which includes the modal year.

Table I is a summary of some of the relevant characteristics observed in the shocked naïve model. The first two columns give the reference dates for the peaks and troughs, respectively. Since one can identify 20 complete business cycles (measured either from trough to trough or from peak to peak) occurring in the 90 years included in the calculation, the average length of a cycle is 4·5 years. This result is in startling agreement with the

[1] A. F. Burns and W. C. Mitchell, *Measuring Business Cycles* (National Bureau, 1946), and W. C. Mitchell, *What Happens During Business Cycles* (National Bureau, 1951), pp. 10–11.

[2] The methods and results of the N.B.E.R. are summarised in Burns and Mitchell, *op. cit.*, and in Mitchell, *op. cit.*

4-year post-Second World War cycles in the United States economy, as well as with the mean length of American peace-time business cycles since 1864.[1] The longest cycle in our data as measured from trough to trough was

TABLE I

*Reference Dating for the Shocked Naive Model*

| Reference dates. | | Elapsed time, years. | | Number of series at peaks which: | | | Number of series at troughs which: | | |
|---|---|---|---|---|---|---|---|---|---|
| Peaks (*P*). | Trough (*T*). | *T* − *P*. | *P* − *T*. | Lead, one year. | Co-incide. | Lag, one year. | Lead, one year. | Co-incide. | Lag, one year. |
| 11 | 8 | 3 | 1 | 4 | 5 | 2 | 4 | 6 | 1 |
| 22 | 12 | 10 | 3 | 1 | 8 | 3 | 2 | 7 | 3 |
| 28 | 25 | 3 | 2 | 0 | 8 | 3 | 3 | 8 | 1 |
| 33 | 30 | 3 | 1 | 4 | 8 | 3 | 5 | 6 | 2 |
| 39 | 34 | 5 | 1 | 3 | 7 | 2 | 5 | 7 | 3 |
| 41 | 40 | 1 | 3 | 2 | 5 | 5 | 3 | 7 | 2 |
| 47 | 44 | 3 | 2 | 3 | 7 | 2 | 2 | 8 | 2 |
| 50 | 49 | 1 | 2 | 3 | 9 | 2 | 3 | 7 | 3 |
| 53 | 52 | 1 | 4 | 1 | 8 | 2 | 5 | 7 | 1 |
| 61 | 57 | 4 | 1 | 3 | 7 | 2 | 3 | 8 | 1 |
| 63 | 62 | 1 | 1 | 2 | 8 | 8 | 5 | 8 | 2 |
| 72 | 66 | 6 | 3 | 5 | 6 | 1 | 4 | 7 | 4 |
| 75 | 73 | 2 | 2 | 4 | 7 | 4 | 4 | 5 | 4 |
| 78 | 77 | 1 | 2 | 2 | 6 | 5 | 6 | 7 | 2 |
| 82 | 80 | 2 | 1 | 4 | 8 | 1 | 2 | 8 | 2 |
| 85 | 83 | 2 | 1 | 4 | 7 | 3 | 2 | 10 | 0 |
| 87 | 86 | 1 | 1 | 3 | 5 | 5 | 5 | 6 | 3 |
| 89 | 88 | 1 | 1 | 5 | 5 | 5 | 3 | 6 | 4 |
| 91 | 90 | 1 | 1 | 6 | 6 | 3 | 4 | 7 | 4 |
| 96 | 92 | 4 | 2 | 2 | 7 | 4 | 2 | 8 | 4 |
| — | 98 | — | — | — | — | — | 2 | 7 | 4 |
| TOTALS | | 56 | 34 | 61 | 137 | 65 | 74 | 150 | 57 |
| Average per cycle | | 2·80 | 1·70 | 3·05 | 6·85 | 3·25 | 3·70 | 7·50 | 2·85 |
| % of specific cycles represented | | — | — | 17·9 | 40·2 | 19·1 | 21·8 | 44·1 | 16·8 |

13 years in duration; the shortest lasted 2 years. The corresponding figures for the United States economy were 9·2 and 2·2 years respectively.

The computed cycles are broken down, in columns 3 and 4, to indicate the duration of the expansion and contraction phases of each cycle. The average expansion covered 2·8 years, while the normal contraction took 1·7. The agreement with the observed figures for the United States (2·0 and 1·8 respectively) is surprisingly good, considering the fact that, in our computations, the length of a single business-cycle stage can be estimated only to an integral number of years.

The validity of this comparison of United States and computed business cycles is dependent, of course, upon the degree of reliability with which the

[1] Computed from the N.B.E.R. dating for the period 1854–1949. We omitted from our averages the Civil War cycle and those corresponding to the two World Wars.

reference dates have been determined. One criterion which can be used is the extent to which specific cycle peaks (troughs) tend to cluster at times coincident with the turning-points of the overall business cycles. In our results 40% of the individual series, on the average, have maxima coincident with an upper turning-point of general business activity, and 44% have minima which coincide with a reference trough. The corresponding figures for the United States economy are 58 and 52%, respectively.[1] In addition, the percentage of specific cycles which lead or lag the business cycle in our computed data are 17·9 and 19·1% at the peaks, and 21·8 and 16·8% at the troughs. The analogous numbers for the United States economy lie between 13 and 16%.[1] Thus, while the computed specific cycles definitely tend to cluster at business-cycle turning-points, the degree of bunching is significantly less in the shocked naïve model than in the United States economy.

All in all, it would appear that there is a fair correspondence between the characteristics of the fluctuations generated by the superposition of random shocks upon economic time series related only through accounting definitions and the nature of the business cycles which actually occur in the United States economy. The mean duration of the cycles and the relative length of their expansion and contraction phases are in close numerical agreement with empirical evidence. The degree of bunching of peaks and troughs, however, while significant, does not approximate actual experience as closely as might be desired. We must therefore study the computed cycles in greater detail.

Table II summarises some of the significant features of the specific cycle patterns observed in the variables of the perturbed naïve model. Columns 2–5 and 10–13 give the data which lead to our grouping of the economic variables into leading, coincident and lagging series. As apparent from these columns, the number of turning-points of the specific cycles which occur in the " other " column is generally comparable to the modal number of events in the leading, coincident or lagging columns. As a result, it was generally impossible to classify the variables of the model unambiguously according to the timing of their turning-points relative to those of the reference cycle. Of the twenty variables listed in Table II, five were completely irregular in their behaviour at the turning-points of the general business cycle (see columns 6 and 14 of this table). Twelve series were classified as coincident-irregular, and one (consumption) as coincident–lagging. Only a single variable, national income ($Y$), tended to have peaks and troughs which coincided consistently with those of the overall reference cycle. It should be noted, though, that, as can be seen by comparing columns 6 and 14 with 7 and 15, except for the tendency towards more erratic behaviour in the computed series, the classification of the variables of

[1] These percentages were estimated from Chart 3 (pp. 16–17) of G. H. Moore, *Statistical Indicators of Cyclical Revivals and Recessions* (National Bureau Occasional Paper 31, 1950).

## TABLE II

*Comparison of Computed and N.B.E.R. Specific Cycles*

| Variable | Properties at peaks. | | | | | | | | Properties at troughs. | | | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | One-year lead. | Coincide | One-year lag. | Other. | Our classification. | N.B.E.R. classification. | Our index of conformity, %. | N.B.E.R. index of conformity. | One-year lead. | Coincide. | One-year lag. | Other. | Our classification. | N.B.E.R. classification. | Our index of conformity, %. | N.B.E.R. index of conformity. | |
| $C$ | 3 | 5 | 5 | 3 | Coinc.–Lag | Coinc. | + 70 | +100 | 3 | 3 | 3 | 7 | Irreg. | Coinc. | − 80 | + 50 | |
| $I$ | 1 | 11 | 5 | 12 | Coinc.–Irreg. | Coinc. | + 90 | +100 | 4 | 14 | 3 | 7 | Coinc. | Coinc. | +60 | +100 | |
| $S_p$ | 3 | 11 | 2 | 12 | Coinc.–Irreg. | Coinc. | + 40 | +100 | 7 | 7 | 4 | 9 | Irreg. | Coinc. | +30 | + 50 | |
| $P_{\mathrm{U}}$ | 4 | 6 | 6 | 15 | Irreg. | Coinc. | + 30 | +100 | 4 | 12 | 1 | 13 | Coinc.–Irreg. | Coinc. | +30 | +100 | |
| $D$ | 3 | 3 | 8 | 9 | Lag–Irreg. | — | + 40 | — | 5 | 4 | 8 | 5 | Lag | — | − 70 | — | |
| $W_1$ | 1 | 8 | 4 | 9 | Coinc.–Irreg. | Coinc. | + 60 | +100 | 1 | 7 | 6 | 8 | Coinc.–Irreg. | Coinc. | 0 | + 50 | |
| $N_w$ | 6 | 8 | 3 | 10 | Coinc.–Irreg. | Coinc. | + 60 | +100 | 4 | 2 | 3 | 12 | Coinc.–Irreg. | Coinc. | − 50 | +100 | |
| $w$ | 2 | 6 | 2 | 5 | Coinc.–Irreg. | Lagging | + 80 | +100 | 2 | 6 | 1 | 5 | Coinc.–Irreg. | Coinc. | − 70 | − 50 | |
| $pA$ | 3 | 12 | 4 | 9 | Coinc.–Irreg. | Coinc. | + 50 | + 50 | 2 | 11 | 6 | 9 | Coinc.–Irreg. | Coinc. | +20 | + 60 | |
| $i_S$, $i_L$ | 3 | 3 | 6 | 13 | Irreg. | — | + 10 | — | 5 | 4 | 6 | 10 | Irreg. | — | − 5 | — | |
| $A_1$ | 4 | 9 | 5 | 15 | Coinc.–Irreg. | Coinc. | + 50 | + 60 | 5 | 11 | 4 | 14 | Coinc.–Irreg. | Coinc. | +40 | + 12 | |
| $L_1$ | 2 | 7 | 8 | 15 | Irreg. | — | + 30 | — | 9 | 9 | 1 | 12 | Irreg. | — | +20 | — | |
| $L_2$ | 1 | 12 | 2 | 14 | Coinc.–Irreg. | — | + 30 | — | 1 | 10 | 3 | 14 | Coinc.–Irreg. | — | +60 | — | |
| $Y$ | 1 | 13 | 3 | 6 | Coinc. | Coinc. | +100 | +100 | 3 | 13 | 2 | 4 | Coinc. | Coinc. | +60 | + 50 | |
| $P$ | 2 | 13 | 3 | 12 | Coinc.–Irreg. | Coinc. | + 60 | — | 6 | 11 | 3 | 9 | Coinc.–Irreg. | Coinc. | +60 | — | |
| $p$ | 6 | 7 | 3 | 11 | Irreg. | Coinc. | + 40 | + 64 | 4 | 8 | 4 | 11 | Coinc.–Irreg. | Coinc. | − 50 | + 82 | |
| $K$ | 0 | 5 | 3 | 6 | Coinc.–Irreg. | — | + 70 | — | 1 | 8 | 1 | 3 | Coinc. | — | − 20 | — | |
| $B$ | 1 | 1 | 3 | 0 | Irreg. | — | +100 | — | 2 | 1 | 0 | 0 | — | — | − 90 | — | |
| $K/Y$ | 2 | 12 | 2 | 10 | Coinc.–Irreg. | — | − 60 | — | 5 | 13 | 2 | 5 | Coinc. | — | − 80 | — | Inverse |
| $w/p$ | 3 | 8 | 4 | 12 | Coinc.–Irreg. | — | + 20 | — | 4 | 9 | 4 | 9 | Coinc.–Irreg. | — | − 10 | — | |

the model into leading, coincident and lagging quantities is generally similar to that of the N.B.E.R.

Columns 8–9 and 16–17 of Table II present the indices of conformity of the specific cycles to the expansions and contractions of the business cycles for both the computed time series and the N.B.E.R. statistics. These indices measure the correlation between the direction of movement in the individual series and that of the overall business fluctuations. As can be seen from this table, there is fairly poor agreement between the indices of conformity of the computed series and those of the N.B.E.R., especially during contractions.

Generally speaking, then, the cycles generated by random uncorrelated shocks upon a system in which the only relationships among the variables are due to accounting procedures bear a certain amount of resemblance to the cycles found in the United States economy. The mean length of the cycles, and the average duration of prosperity and recession, agree fairly well with United States experience. On the other hand, the tendency towards a clustering of turning-points of specific cycles at reference peaks and troughs is significantly weaker in the computed cycles than it is in practice. And, in addition, the computed time series were much more erratic in their lead–lag behaviour than their counterparts in the United States economy.

## III. The Klein–Goldberger Model

To help us assess these results, let us see how they compare with those obtained when the dynamic behaviour of the shocked 1954 Klein–Goldberger econometric model of the United States economy was studied in the same manner. The details of the Klein–Goldberger investigation are discussed in the October 1959 issue of *Econometrica*, and will not be given here.

Table III summarises the characteristics of the reference cycles in the shocked Klein–Goldberger economy in a form similar to that of Table I. As before, the mean duration of the computed cyclical swings (4·0 years) and the relative length of the average expansion and contraction (2·6 and 1·5 years respectively) are in close agreement with the actual data for the United States. Unlike in the shocked naïve model, however, the specific cycle peaks and troughs of the Klein–Goldberger system tend to cluster more markedly at reference turning dates: In the Klein–Goldberger calculations 51% of the specific cycle peaks and 52% of specific cycle troughs occurred at reference extrema, as compared to only 40 and 44% for the naïve model. Thus, the substitution of the economic interactions of the Klein–Goldberger system for the simple extrapolations of the naïve scheme leads to a decided improvement in the characteristics of the reference cycle.

However, for an adequate description of actual experience we must require, in addition, that the specific cycle patterns observed be realistic as

TABLE III

*Reference Dating for Shocked Klein–Goldberger Model*

| Reference dates. | | Elapsed time, years. | | Number of series at peaks which: | | | Number of series at troughs which: | | |
|---|---|---|---|---|---|---|---|---|---|
| Trough (*T*). | Peak (*P*). | *T* – *P*. | *P* – *T*. | Lag, one year. | Co-incide. | Lead, one year. | Lag, one year. | Co-incide. | Lead, one year. |
| — | 27 | — | 2 | — | — | — | — | — | — |
| 29 | 31 | 2 | 1 | 2 | 8 | 6 | 1 | 6 | 4 |
| 32 | 37 | 5 | 1 | 1 | 8 | 5 | 4 | 7 | 4 |
| 38 | 42 | 4 | 1 | 1 | 10 | 0 | 1 | 13 | 1 |
| 43 | 45 | 2 | 1 | 2 | 7 | 4 | 0 | 10 | 0 |
| 46 | 51 | 5 | 2 | 2 | 11 | 1 | 3 | 8 | 3 |
| 53 | 54 | 1 | 2 | 4 | 12 | 1 | 2 | 10 | 4 |
| 56 | 59 | 3 | 1 | 1 | 10 | 1 | 1 | 11 | 4 |
| 60 | 63 | 3 | 1 | 2 | 7 | 6 | 4 | 6 | 2 |
| 64 | 68 | 4 | 2 | 6 | 6 | 3 | 5 | 7 | 1 |
| 70 | 72 | 2 | 1 | 2 | 7 | 3 | 1 | 13 | 1 |
| 73 | 74 | 1 | 1 | 2 | 9 | 1 | 2 | 8 | 2 |
| 75 | 77 | 2 | 1 | 2 | 8 | 4 | 0 | 10 | 2 |
| 78 | 79 | 1 | 1 | 2 | 8 | 2 | 3 | 9 | 3 |
| 80 | 83 | 3 | 2 | 2 | 12 | 1 | 1 | 7 | 3 |
| 85 | 86 | 1 | 2 | 4 | 12 | 2 | 2 | 11 | 2 |
| 88 | 90 | 2 | 1 | 2 | 12 | 2 | 1 | 11 | 4 |
| 91 | 94 | 3 | 2 | 3 | 10 | 1 | 3 | 11 | 3 |
| 96 | 98 | 2 | 4 | 5 | 8 | 3 | 1 | 9 | 3 |
| 102 | 106 | 4 | 1 | 3 | 12 | 2 | 3 | 10 | 2 |
| 107 | 109 | 2 | 1 | 4 | 9 | 1 | 5 | 11 | 2 |
| 110 | 113 | 3 | 1 | 2 | 11 | 4 | 5 | 7 | 1 |
| 114 | 116 | 2 | 1 | 5 | 7 | 4 | 3 | 13 | 0 |
| 117 | 119 | 2 | 1 | 1 | 8 | 8 | 4 | 9 | 3 |
| 120 | — | — | — | — | — | — | — | — | — |
| TOTALS . . | | 59 | 34 | 60 | 212 | 65 | 55 | 217 | 54 |
| Average per cycle. | | 2·56 | 1·48 | 2·61 | 9·22 | 2·82 | 2·39 | 9·43 | 2·34 |
| % of specific cycles represented . | | — | — | 14·5 | 51·2 | 15·7 | 13·3 | 52·4 | 13·0 |

well. Table IV presents a comparison of the Klein–Goldberger and N.B.E.R. specific cycles, in a form analogous to that of Table II. As can be seen by comparing columns 6 and 14 of the two tables, the Klein–Goldberger model succeeds in removing the indeterminacy present in the naïve system. Only agricultural incomes ($A_1$) remain irregular in their pattern of behavior in the Klein–Goldberger data. But, in view of the low index of conformity reported by the N.B.E.R. for this variable, this may not be unrealistic. In addition, there is also extremely close agreement between the N.B.E.R. and the Klein–Goldberger classification of variables into leading, lagging and coincident series. Eleven Klein–Goldberger variables are classified as coincident at both peaks and troughs. These are: national income ($Y$), gross investment ($I$), private employee compensation ($W_1$), non-wage, non-farm income ($P$), employment ($N_W$), corporate profits ($P_C$), corporate savings ($S_P$), corporate surplus ($B$), capital stock ($K$), the

## TABLE IV

*Comparison of Klein–Goldberger and N.B.E.R. Specific Cycles*

| Variable. | Properties at peaks. | | | | | | | | Properties at troughs. | | | | | | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | One-year lead. | Coincide. | One-year lag. | Other. | K.–G. classification. | N.B.E.R. classification. | K.–G. index of conformity, %. | N.B.E.R. index of conformity, %. | One-year lead. | Coincide. | One-year lag. | Other. | K.–G. classification. | N.B.E.R. classification. | K.–G. index of conformity, %. | N.B.E.R. index of conformity, %. | |
| $I + T + D$ | 1 | 21 | 1 | 1 | Coinc. | Coinc. | +100 | +100 | 2 | 21 | 0 | 1 | Coinc. | Coinc. | + 92 | + 50 | |
| $T$ | 1 | 21 | 1 | 1 | Coinc. | Coinc. | +100 | +100 | 1 | 22 | 0 | 1 | Coinc. | Coinc. | +100 | + 50 | |
| $C$ | 1 | 8 | 5 | 0 | Coinc. | Coinc. | +100 | +100 | 5 | 5 | 1 | 1 | Leading–Coinc. | Coinc. | − 17 | + 50 | |
| $I$ | 4 | 20 | 0 | 3 | Coinc. | Coinc. | +100 | +100 | 0 | 23 | 1 | 3 | Coinc. | Coinc. | +100 | +100 | |
| $W_1$ | 2 | 19 | 0 | 5 | Coinc. | Coinc. | + 83 | +100 | 1 | 10 | 3 | 5 | Coinc. | Coinc. | + 8 | + 50 | |
| $A_1$ | 6 | 8 | 7 | 2 | Irreg. | Coinc. | − 4 | + 60 | 8 | 5 | 5 | 10 | Irreg. | Coinc. | − 33 | + 12 | |
| $P_1$ | 4 | 19 | 7 | 0 | Coinc. | Coinc. | + 91 | — | 0 | 22 | 1 | 4 | Coinc. | Coinc. | +100 | — | |
| $P_2$ | 4 | 18 | 4 | 2 | Coinc. | Coinc. | + 91 | +100 | 5 | 19 | 2 | 2 | Coinc. | Coinc. | +100 | +100 | |
| $S_1$ | 4 | 20 | 4 | 2 | Coinc. | Coinc. | +100 | +100 | 5 | 20 | 1 | 4 | Coinc. | Coinc. | + 92 | +100 | |
| $R$ | 4 | 15 | 4 | 4 | Coinc. | Coinc. | + 83 | +100 | 0 | 17 | 1 | 3 | Coinc. | Coinc. | +100 | + 50 | |
| $K_1$ | 0 | 5 | 1 | 1 | Coinc. | — | +100 | — | 1 | 5 | 1 | 0 | Coinc. | — | − 42 | — | |
| $D_1$ | 1 | 9 | 1 | 0 | Coinc. | — | + 57 | — | 0 | 11 | 3 | 1 | Coinc. | — | + 33 | — | |
| $L_1$ | 10 | 6 | 6 | 3 | Leading | — | + 22 | — | 10 | 7 | 4 | 5 | Leading | — | − 25 | — | |
| | 14 | 4 | 5 | 5 | Leading | — | + 13 | — | 5 | 6 | 9 | 5 | Lagging–Irreg. | — | + 8 | — | |
| $L_2$ | 4 | 15 | 0 | 4 | Coinc. | — | − 65 | — | 2 | 17 | 3 | 1 | Coinc. | — | − 83 | — | Inverse |
| $A_2$ | 3 | 17 | 2 | 0 | Coinc. | Coinc. | +100 | + 64 | 2 | 20 | 2 | 0 | Coinc. | Coinc. | + 83 | + 82 | |
| $\Delta A$ | 4 | 17 | 9 | 2 | Coinc. | Coinc. | +100 | + 50 | 0 | 14 | 4 | 4 | Coinc. | Coinc. | + 42 | + 60 | |
| $n/p$ | 0 | 1 | 1 | 1 | Lagging | Lagging | + 83 | +100 | 6 | 4 | 7 | 0 | Lagging | Coinc. | − 67 | − 50 | |
| $E/T$ | 2 | 17 | 4 | 1 | Coinc. | — | − 74 | — | 0 | 21 | 0 | 4 | Coinc. | — | − 100 | — | Inverse |
| | 4 | 19 | 1 | 4 | Coinc. | — | −100 | — | 5 | 19 | 1 | 3 | Coinc. | — | −100 | — | Inverse |

general price index ($p$) and the index of agricultural prices ($p_A$). Consumption ($C$) coincides at peaks, but has a tendency to lead at troughs. And corporate liquid assets ($L_2$), real wages ($w/p$) and the capital/output ratio ($K/Y$) are in inverse coincidence with the business cycle in the sense that their troughs tend to occur at reference peaks, and vice versa. All of these results are in accord with N.B.E.R. experience (when available), except that United States specific cycles for consumption coincide, rather than lead, at the troughs. In addition, as evident from columns 8–9 and 16–17 of this table, the indices of conformity calculated for the Klein–Goldberger statistics are quite consistent with those given by Mitchell for the United States economy.

Generally speaking, then, it would appear that the specific cycles generated in the Klein–Goldberger model by random shocks resemble the cycles found in the United States economy much more closely than do those of the naïve model. Since, in addition, the characteristics of the reference cycles of the Klein–Goldberger model are also more satisfactory, we conclude that the shocked Klein–Goldberger equations offer a better approximation to United States cyclical experience than does the shocked naïve model.

## IV. Discussion

When the work described in this paper on a minimal stochastic model of a complex industrial economy is compared with the earlier investigation on the Klein–Goldberger system three facts stand out:

(1) a minimal stochastic model is reasonably satisfactory in simulating business fluctuations in the United States;

(2) the Klein–Goldberger equations by themselves describe a non-oscillatory economy;

(3) the superposition of random shocks upon the Klein–Goldberger system leads to an extremely close representation of the cyclical fluctuations of American business activity.

These results suggest that it is the stochastic features of the shocked Klein–Goldberger model, rather than the interactions described directly by the Klein–Goldberger equations themselves, which are responsible for the excellent agreement with reality mentioned above. We have not, of course, proved that business cycles are stochastic in origin, but it is my belief that the evidence presented here creates a strong presumption in favour of this hypothesis. This is especially significant in view of the absence (to date) of a completely satisfactory endogenous theory of business cycles.

It would also appear that there is some validity to the Klein–Goldberger description of the interactions which take place among the several sectors of the economy. That is to say, the interrelations which exist among

economic units must be incorporated in a reasonable manner into any rational description of the dynamic behaviour of an industrial complex. A purely stochastic theory of cyclical fluctuations constitutes merely a first approximation to reality.

The implications for the student of business cycles are quite clear. The theorist need not explain a determinate economic path with observable oscillations at predetermined points of time. If he accepts the stochastic hypothesis he knows how and why business cycles arise: the normal perturbations upon the day-to-day operation of an economy suffice to generate a persistent oscillatory process of the observed magnitude. The primary task of the business-cycle analyst is to investigate the reaction patterns of an economic system to various shocks, for it is in this sphere of activity that his efforts are likely to be most significant.

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## APPENDIX A

### 1. *Explanation of Symbols*

| | |
|---|---|
| $Y + T + D$ | Gross national product, 1939 dollars |
| $C$ | Consumer expenditures, 1939 dollars |
| $I$ | Gross private domestic capital formation, 1939 dollars |
| $G$ | Government expenditures for goods and services, 1939 dollars |
| $p$ | Price index of gross national product, 1939 : 100 |
| $W_1$ | Private employee compensation, deflated |
| $W_2$ | Government employee compensation, deflated |
| $D$ | Capital consumption charges, 1939 dollars |
| $P_C$ | Corporate profits, deflated |
| $S_P$ | Corporate savings, deflated |
| $T$ | Indirect taxes less subsidies, deflated |
| $K$ | End-of-year stock of private capital, 1939 dollars from arbitrary origin |
| $p_A$ | Index of agricultural prices, 1939 = 100 |
| $p_1$ | Index of prices of imports, 1939 = 100 |
| $N_p$ | Number of persons in the United States |
| $N$ | Number of persons in the labor force |
| $N_w$ | Number of wage-and-salary-earners |
| $N_g$ | Number of government employees |
| $N_f$ | Number of farm operators |
| $N_e$ | Number of non-farm entrepreneurs |
| $h$ | Index of hours worked per year, 1939 = 100 |
| $w$ | Index of hourly wages, 1939 = 122·1 |
| $P$ | Non-wage, non-farm income, deflated |
| $A_1$ | Farm income deflated |
| $A_2$ | Government payments to farmers, deflated |
| $i_L$ | Average yield on corporate bonds, % |
| $i_S$ | Average yield on short term commercial paper, % |
| $L_1$ | End-of-year liquid assets held by persons, deflated |
| $L_2$ | End-of-year liquid assets held by businesses, deflated |
| $t$ | Time trend, years, $t = 2$ in 1952 |
| $B$ | End-of-year corporate surplus, deflated, from arbitrary origin |

### 2. *The Naïve Model*

$$(1)\quad C_t = 111{\cdot}9 + 2{\cdot}72t + \delta_c$$
$$(2)\quad I_t = 26{\cdot}2 + 1{\cdot}17t + \delta_I$$
$$(3)\quad S_{Pt} = 2{\cdot}85 + 0{\cdot}20t + \delta_{S_P}$$
$$(4)\quad P_{Ct} = 18{\cdot}53 + 1{\cdot}23t + \delta_{P_C}$$
$$(5)\quad D_t = 18{\cdot}76 + 1{\cdot}21t + \delta_D$$
$$(6)\quad (W_1)_t = 77{\cdot}25 + 2{\cdot}69t + \delta_{W_1}$$
$$(7)\quad (Nw)_t = 54{\cdot}68 + 1{\cdot}13t + \delta_{N_w}$$
$$(8)\quad W_t = 326{\cdot}8 + 17{\cdot}92t + \delta_W$$
$$(9)\quad (p_A)_t = 305 + 7{\cdot}07t + \delta_{p_A}$$
$$(10)\quad i_S = 2{\cdot}5 + \delta_{i_S}$$
$$(11)\quad i_L = 3{\cdot}5 + \delta_{i_S}$$
$$(12)\quad (A_1)_t = 7{\cdot}3 + \frac{2{\cdot}5}{t+7} + \delta_A$$
$$(13)\quad (L_1)_t = 92{\cdot}44 + \frac{16{\cdot}76}{t+7} + \delta_{L_1}$$
$$(14)\quad (L_2)_t = 35{\cdot}88 + \frac{6{\cdot}69}{t+7} + \delta_{L_2}$$
$$(15)\quad G_t = 32{\cdot}933 + 0{\cdot}567t$$
$$(16)\quad (W_2)_t = 15{\cdot}114 + 0{\cdot}578t$$
$$(17)\quad T_t = 14{\cdot}146 + 0{\cdot}514t$$
$$(18)\quad (A_2)_t = 0{\cdot}108 + \frac{0{\cdot}0746}{t+7}$$
$$(19)\quad h_t = 1{\cdot}062$$
$$(20)\quad Y_t = C_t + I_t + G_t - T_t - D_t$$
$$(21)\quad P_t = Y_t - (W_1)_t - (W_2)_t - (A_2)_t - (A_1)_t$$
$$(22)\quad p_t = \frac{h_t\, w_t\, (Nw)_t}{(W_1)_t + (W_2)_t}$$
$$(23)\quad K_t = K_{t-1} + I_t - D_t$$
$$(24)\quad B_t = B_{t-1} + S_P$$

### 3. *Standard Errors Used for Shocks*

| Variable | % Standard deviation |
|---|---|
| $C$ | 1·07 |
| $I$ | 9·79 |
| $S_P$ | 61·4 |
| $P_C$ | 9·43 |
| $D$ | 3·97 |
| $W_1$ | 2·41 |
| $N_w$ | 2·89 |
| $w$ | 1·49 |
| $p_A$ | 7·29 |
| $i_S$ | 20·00 |
| $i_L$ | 14·28 |
| $A_1$ | 10·2 |
| $L_1$ | 3·0 |
| $L_2$ | 3·57 |

# EARNINGS ON RAILWAY CAPITAL

THE main purpose of this article is to classify the various sources from which net earnings from railway capital may be derived, net earnings being defined as any surpluses earned in excess of current working expenses and depreciation. It will be shown that whereas two kinds of surplus reflect real economic or " opportunity " costs, the earning of which is indispensable to the sustained and profitable operation of any railway undertaking, another kind, however much it was expected to be earned by past lenders and investors, is a surplus earned rather than an economic cost incurred, the realisation of which is by no means a requirement of that sustained and profitable operation referred to, even in the long run: and that much the greater part of all these earnings, so far from being a central charge, overhead *to the railway as a whole*, can be clearly identified with particular services, types of equipment and localities. Whilst no attempt is made to deal fully with all the implications for policy of such an analysis, the article does conclude with some discussion both as to the extent to which interest on railway capital should be regarded as an item " properly chargeable to revenue " and of the economic consequences of protecting undertakings whose financial fortunes have failed to come up to expectations. It is also hoped that it does throw some light on the nature of the capital burden for which the British Transport Commission have assumed responsibility in respect of British Railways[1] and London Transport (railways) since the passing of the Transport Act of 1947. A brief description of the various sources from which earnings on railway capital may derive will be followed by a much fuller account of them.

[1] The proportion of all the Central Charges of the Commission (much the greater part of which consists of interest on British Transport Stock), which, in the Commission's view, can be allocated to British Railways " cannot be made by reference to some precise formula but is a matter of judgement based on the relevant circumstances " (*British Transport Commission's Annual Report and Accounts* 1959, Volume II, p. 10). But from the start the sums so allocated have been substantial. In 1948 the figure stood at £32 million. By 1955 it had risen to £40 million. And only by means of a system of deficit financing and capital advances under the Transport (Railway Finances) Act 1957 was the figure held at £42 million for 1959. But in future interest charges are going to be considerably greater. In the words of the Select Committee on Nationalised Industries (British Railways), " Central charges (allocated to the railways) are expected to have risen by nearly 50% by 1963, to £62 million, and will go on rising. In addition, the deficit advances must begin to be repaid in 1963, and the interest on the deficit advances will all become chargeable to Revenue Account at the beginning of 1965 " (para 145). That the railways and the Commission are not in fact going to meet all these commitments was recognised by the Chancellor in his last Budget Statement (April 1960), when he transferred the sum of £90 million from below the line to above the line, thus meeting out of revenue a sum sufficient to cover the deficit in the Consolidated Revenue Account of British Railways for the year 1959.

First, they may derive from land and property[1] required for providing railway services but which also have a value in uses other than for running the railway. Particularly in built-up areas, our railways occupy much land which could command a high value in other uses. Unless a railway undertaking can earn a surplus from this land commensurate with what it could earn by selling or letting it out for other purposes, it is suggested that it should be so sold or let.

Second, there is the interest earned on all wasting assets, such as rolling-stock or any other equipment or stores that require renewal or replacement, and therefore the investment of resources from time to time. Interest earned from this type of investment simply reflects the cost of financing the provision of all wasting assets, and as will be seen later is highly variable in amount.

Third, there are the earnings from the first class of assets (land, etc.) apart from and in excess of their value in other uses: earnings that is to say from assets which are not only technically durable such as is land but also specific to providing railway services. Much of the capital invested in tunnels, embankments and cuttings has created assets of this kind. In view of the large proportion of the initial capital invested in railways (especially underground or tube railways), which may be accounted for by the creation of these kinds of assets, and the importance therefore which attaches to the question as to whether this class of surplus earned should or should not be regarded as a cost "properly chargeable to revenue," special attention will be given to it.

Fourth, there are earnings that reflect some degree of monopoly that may be possessed by a railway. Whether it is possible or useful to separate the earnings derived from this monopoly element from other earnings is doubtful. Finally, some net earnings may be in lieu of and in reward for past risk-taking.

We shall now examine and assess the significance of these potential sources of net revenue in more detail.

## I. Occupation of Land which Has a Value in Uses other than for Railways

Owners of railway undertakings have from the start owned land on an extensive scale, and have therefore, from an economic point of view, assumed the role of both landlord and tenant. Some indication of the extent of the land owned by the British Transport Commission in respect of their railway business in the County of London alone was given in the late Sir Patrick Abercrombie's *County of London Plan*, in which he wrote: "A conservative

[1] We are here considering only land and property which are essential for providing railway services proper. We are not therefore considering such assets as hotels or other properties which can be valued apart from their contribution to the running of the railway undertaking as a whole.

estimate of the acreage of railway property within the County boundary is 3,350 acres, *i.e.*, nearly half the total area of public open space" (p. 66, para. 254).[1] There can be little doubt that much of the land referred to, as well as that in other parts of Great Britain, has considerable value in uses other than for railway purposes, whether for housing schemes, open spaces or business premises. And the sums for which such land or property could at any time be let, sold or leased to others for such purposes are a measure of the cost to the Commission of their retaining it for railway purposes. For potential net revenue is being foregone, and unless the land in question is deemed by the Commission to be earning, directly or indirectly, at least as much as that potential revenue it would presumably be to its financial advantage to let it go. The holding on to it for railway purposes is also a cost to society, in that such land is being withheld from other, possibly dearly wanted, purposes. It would seem, therefore, that it is in the interests both of the Commission and of the community that such land should be retained for railway purposes only if the services rendered to the public by so doing are wanted sufficiently to earn a surplus or ground rent commensurate with or in excess of the surplus that could be earned (after transfer costs have been incurred) by letting it out for other purposes. This first class of earning, then, represents a very real and comparatively short-run cost, measuring as it does the cost, both to the Commission and the community, of occupying land for which there are alternative uses and demands.

## II. Interest on Investment in all Wasting Assets

The second type of surplus earning to be noted is that required to finance the provision of all wasting assets whose economic lives are known to be limited, and which, therefore, require to be replaced from time to time in order to maintain a given standard of service. Just as road vehicles are required to earn a rate of interest if investment and re-investment is to be undertaken, so also in the case of capital investment in such assets as railway rolling-stock, and all the many other kinds of railway equipment which require physical and periodic replacement. Now an outstanding characteristic of much railway equipment is not only its technical longevity[2] but also that it may have a very long revenue-earning life too. But all railway assets are not long-lived, either technically or commercially. Indeed, it can be said

[1] Such estimates should not be taken as implying, far less as proving, that British Railways occupy "too much" land. Indeed, in respect of some of their operations such as the handling of freight at particular depots and terminals, they may well be in need of more space for manœuvre. Similarly on the passenger side, the purchase of additional land for the provision of more parking space for private cars at suburban railway stations might well be a sound investment, and, incidentally, promote the true co-ordination of road and rail transport.

[2] Which may all too easily lead to unduly optimistic assumptions as regards its revenue-earning life.

that there is an almost infinite variety of assets in this respect, ranging from station buildings, viaducts and rolling-stock which may " last " for half a century or more before requiring replacement, to the provision of such short-lived assets as upholstery, brake-blocks and rails at curves and junctions. What is common to them all is that to maintain them, in the sense of having to replace them from time to time, requires some saving and investment, some " financing," and that unless the services for which they are required are wanted sufficiently to cover the cost of that saving and investment, represented by the interest payment required to evoke them, such services are not " paying their way." In short, this second class of interest is also essentially a cost of provision " property chargeable to revenue " both in the short and long run,[1] and incidentally can be highly variable.

In the case of the railway industry the fact of longevity can be of special importance. For, as already mentioned, among the assets employed, although some are short-lived, others are exceptionally long-lived, both technically and economically. For safety's sake alone, great " strength " and technical durability must be given to rolling-stock, parts of the permanent way, embankments, bridges and viaducts, and they may also remain real revenue-earning assets for many decades. *In the end,* however, if continued operation is intended and financially justified, it is assumed they require replacement. During the life of the original asset, say as much as fifty years or more, any interest earned is in the nature of a surplus—a measure of its profitability, the opportunity cost of using it being the shorter-run costs of working and maintaining it in a state of efficiency. But when and if replacement is ultimately required, then unless this replacement investment again holds out prospects of earning a rate of interest commensurate with earnings elsewhere, the investment will presumably not be undertaken. The constant drive to " reduce stocks " of all kinds, including the total amount of rolling-stock required, is mainly an effort to economise on this capital account, *i.e.*, to save interest on money borrowed for providing such assets. This second type of surplus earned is therefore very much of a cost of running a railway, and, in view of the immense sums which are necessarily locked up in railway rolling-stock and other wasting assets, not to mention the relatively high " real " rate of interest prevailing in this country at the present time, is an item of cost of considerable magnitude.

From the " cost " point of view it is significant that this important kind of cost is anything but a cost overhead or fixed in relation to the railway as a whole. On the contrary, it is highly allocatable to the provision of specific types and kinds of rolling-stock, passenger or freight. And in so far as it can be associated with other types of assets, such as signalling equipment, rails,

[1] It should be noted, however, that only over periods longer than the economic life of any one of these kinds of assets should this class of surplus earning be regarded as an avoidable cost of provision. What is deemed to be a " short " or " long "-run cost depends on the length of time one chooses to ascribe to the terms " long " and " short."

sleepers and ballast, and many terminal facilities, it would appear that it is for the most part a *local* cost of provision, *i.e.*, anything but a "central charge." In view of the wide differences in traffic density that can be commercially justified in different circumstances, thereby calling for widely different amounts of rolling-stock to be maintained, this cost can also be regarded as highly variable in amount.

It would seem that so long as revenue earned is sufficient to cover the two classes of surplus earning so far mentioned, all the costs *required* to justify financially the continued operation of a railway are being covered.

## III. Earnings from Assets which Are both Technically Durable and Specific to Railway Transport

The third type of earning to be considered and explained is that which reflects the value or earning power of those durable [1] assets referred to under Category I above, *less* the latter's value or earning power in uses other than a railway: earnings that is to say on assets which are not only durable as in I, but are also specific in that they do *not* have any value other than for purposes in connection with running the railway. Yet they were indispensable to the construction of the railway as a whole, and had there not been prospects of earning a rate of interest on the money invested, the investment would not have taken place. Although the assets associated with this third class of earning may be physically indistinguishable from those associated with the first, the earnings therefrom are separate from and irrespective of what such assets could earn in uses other than for railway transport. In a sense, the earnings referred to as Category I represent the scrap or outside value of the assets with which we are now concerned.

Examples of this sort of capital expenditure are the initial purchase of land and rights of way (including legal and Parliamentary expenses) and a large part of the expenditure involved in the boring of tunnels, the excavation of cuttings and the building of embankments.[2] Such initial expenditure is normally charged to capital account, and in the case of building an underground railway may account for as much as 50% of the total initial capital expenditure incurred. It reflects the magnitude of investors' hopes and expectations of earning net revenue. But the assets so created may have virtually no value in uses other than for a railway. Nor does that part of

[1] The fact that they are durable does not, of course, imply that they will, or are even expected to maintain indefinitely their economic efficiency, *i.e.*, value. Indeed, they may require to be drastically depreciated in a relatively short time. On the other hand, they may have been expected at the time of the first investment to maintain their revenue-earning capacities for a very long time, if not indefinitely. It is the interest earned or expected to be earned on this class of capital with which we are here concerned.

[2] In the case of the construction of railways in insufficiently mapped parts of the world extensive and expensive surveys may be required before alignments are determined. Once this expenditure has been incurred, it need never be incurred again. Yet it may have substantially increased the initial capital expenditure and therefore the financial commitments entered into.

the initial expenditure that we are now considering ever have to be undertaken a second time.[1] The future cost of keeping the line technically "efficient" consists of whatever is required to maintain it in that condition, which does *not* include the meeting of commitments in respect of Bond or Debenture issues. Although man-made, once created, these physical assets are from an economic point of view indistinguishable from land, or such "natural" features of the landscape as valleys. Once excavated, there is no difference from an economic point of view between a valley which was man-made (a cutting) and one that was carved out by Nature over a period of a million or more years. It is suggested that the earnings from this class of asset, other than what is earned under I, in no sense reflect or measure current or future opportunity costs proper, either in the short or long run. They are *surpluses earned* over and above short- and long-run costs, expected and hoped for by investors, but manifestly *not* a *sine qua non* to the continued and profitable use of the assets concerned. For so long as the revenue earned from the services rendered are sufficient to cover the full costs of maintenance and operation, together with the rent and interest referred to under Sections I and II above, which together may fall far short of original expectations, it is more profitable to continue to operate and earn some surplus on the class of capital in question, however small, rather than close down and thus earn no surplus whatever. Indeed, even if no surplus whatever was earned upon it, it would still be worth re-investing in wasting assets and incurring operating costs, so long as revenue-earning prospects justified such re-investment and operation. It has sometimes been represented that if an undertaking is allowed, as the result of competition, to fall into difficulties to the extent of failing to earn net revenue commensurate with original expectation the public will, as a result, be deprived of "much needed facilities." And of course there have been cases of services becoming so unremunerative as to justify the withdrawal of services, *e.g.*, the closing of branch lines. But it is altogether wrong to assume that because an undertaking gets into financial difficulties, even to the extent of failing to meet interest payments on Debenture stock, it therefore follows that it is no longer to anybody's interest to continue to provide the services in question, and that the public will accordingly be deprived thereof.

The figures which are set out in Tables I and II below illustrate this point.

[1] As might be expected, similar circumstances obtain in the construction of new roads. In their First Report (Session 1958–59) dealing with the cost of Trunk Roads, the Select Committee on Estimates said "earth moving accounts for half the cost of road construction and . . . if a shilling per ton could be saved, the cost of the London–Birmingham motorway would be reduced by £1 million (Q.163)." The relevant passage in the question referred to ran as follows: "I have a letter from Sir Owen Williams, the engineer on roads, who pointed out that on a job like the London–Birmingham motorway the cost of excavation does amount to roughly half the total cost, just shifting dirt; and that if the contractors could find a way of saving a shilling a ton on the dirt they would save £1 million. This, I think, is quite a telling figure. It shows that this dirt shifting does really mean something." Here also it can be assumed that for the most part such dirt shifting will never be required to be done over again.

It will be seen that in spite of financial failure and legal insolvency, it still "paid" to run the railway. Let us suppose that a railway (or part of a railway) has been built for the total capital cost of £1,000,000 and that the hoped for earnings on the investment were at the rate of 5%, *i.e.*, £50,000 per annum. Of that total of £1,000,000 as much as £500,000 had been required in respect of the purchase of land and rights of way and the construction of those permanent and durable assets such as tunnels, cuttings and embankments referred to above. But the "outside" residual value of these assets, once created, amounted to the sum of £100,000 only, *i.e.*, an assumed annual rental of £5,000. The annual opportunity cost, therefore, of the continued occupation of this "land" can be said to be £5,000. Superimposed upon this land so purchased and suitably moulded for railway purposes was added at a cost of £200,000 rails, ballast, signalling equipment and station buildings, all of which in due course were assumed to require replacement and the re-investment of funds from time to time if operation on the scale contemplated in the first instance was to be maintained. Unless, therefore, these wasting assets were capable of earning at least £10,000, or 5% on that £200,000, replacement would not be justified. In other words, one of the long-run "costs" of maintaining such assets was an interest payment of some £10,000. The remaining £300,000 were invested in rolling-stock, which also required replacement from time to time and an interest payment of some £15,000 per annum to justify such replacement.

The above figures illustrate the significance of cases where a large part of the initial capital outlay has been spent in ways which, even to maintain output indefinitely, need never be spent over again. They show that the larger the proportion of the original capital that was spent in this way, the larger may be the shortfall from expectations to earn, before the undertaking is failing to cover those costs, including some capital costs, which must be covered to justify financially the continued operation of the line. They explain and illustrate why railways, whilst they may only be able to earn 3 or 3¼% on their *original* capital investment, have no reason to close down, even though the rate of borrowing both at the time of construction and thereafter was (say) 5%. For the wasting assets may well be earning a full 5% or more, and so justifying their replacement. They also provide a simple explanation of why railways can go bankrupt (a common phenomenon in American history) without *necessarily* closing down or ceasing to provide a public service. For supposing the £1,000,000 required for the undertaking in question had been raised in the proportions of £750,000 in the form of Debenture 5% Stock, and £250,000 in the form of Ordinaries (see Table II), then a net earning of £37,500, would be required to meet the interest requirements of Debenture Stock holders and avoid bankruptcy. But the net earnings required to justify continued operation was only £30,000 (see Table I). Thus, failure to meet the requirements of

Debenture Stock holders would not in this case have involved the withdrawal of the public services in question. In short, they demonstrate that there may be a substantial difference between: (i) the earnings required to

TABLE I

*Figures showing the Proportion of the Total Amount Spent on the Construction of a Railway that may go into* (a) *Land and Other Non-wasting Assets, and* (b) *and* (c) *Wasting Assets, and the Consequent Divergence there may be between* (i) *Original Expectations to Earn,* (ii) *Earnings Required to Justify Financially the Continued Provision of Services and* (iii) *Actual Earnings*

| Type of asset created. | Initial capital expenditure on each class of asset. | (i) Expected earnings at time of original investment at 5%. | (ii) Earning required to justify retention and replacement of assets. | (iii) Supposed actual earnings. | Shortfall from expectations. |
|---|---|---|---|---|---|
| | £ | £ | £ | £ | £ |
| (*a*) Land, property and other non-wasting assets . . . | 500,000 | 25,000 | | 10,000 | 15,000 |
| Value of these assets in other uses (£100,000) expressed as foregone annual rent, *i.e.*, opportunity cost of retention | | | 5,000 | | |
| (*b*) Those parts of the permanent way, including signalling equipment and other wasting assets, which require replacement from time to time | 200,000 | 10,000 | 10,000 | 10,000 | |
| (*c*) Rolling-stock . . . | 300,000 | 15,000 | 15,000 | 15,000 | |
| TOTALS . . . | £1,000,000 | £50,000 | £30,000 | £35,000 | £15,000 |

TABLE II

*Showing Means by which Railway was Financed, and Comparison between Expected and Actual Earnings*

| | Amount. | Expected earnings. | Actual earnings. |
|---|---|---|---|
| | £ | £ | £ |
| Debenture 5% Stock . . . | 750,000 | 37,500 | 35,000 |
| Ordinary Stock . . . . | 250,000 | 12,500 (minimum) | Nil |
| | £1,000,000 | £50,000 | £35,000 |

cover the future economic costs of running a railway, and (ii) the earnings required to meet all the original hopes and expectations to earn.

What significance, if any, has the above analysis, either to our way of thinking about the nature of railway costs or to other matters of transport

policy generally? First, it shows that in so far as interest earned on railway capital constitutes a genuine economic cost at all (and nothing I have said implies that the amount of saving and investment required to maintain the provision of services on British Railways at current levels is small), most of it is anything but a cost "overhead to the railway system *as a whole*." On the contrary, it can be identified with particular types of equipment, services and localities. If at any time, therefore, an attempt was made to make British Railways or London Transport, or parts thereof, financially viable (in the sense of covering all economic or opportunity costs) such interest would be among the costs that could to a large extent be identified with particular assets and localised. In so far, however, as there are at any one time, and in addition to these capital "costs," substantial financial commitments entered into in respect of the durable and specific assets referred to, the important question of principle as to whether and to what extent the service of such debts should be regarded as an item "properly chargeable to revenue" remains. In coming to any decision on this matter a distinction should be made between the position *before* any particular investment has taken place and after that event. As regards the position before the event, in so far as it is policy to rely on private enterprise to provide the kind of facilities and services we have in mind, a Government really has no choice in the matter. For unless there are reasonably good prospects of being allowed to earn revenue sufficient to cover not only the costs of operating and maintaining the services for so long as they are required but also interest and depreciation on the *whole* of the investment, including that part of it that is going into those durable and specific assets to which attention has been specially drawn, such an investment would presumably not be undertaken. By the same token, if it is the duty of a nationalised undertaking both to pay its way and balance its financial budget as a whole, and also (so far as is practical) to justify every particular investment on financial grounds, such an undertaking would not be able to go ahead with many important projects, unless assured of the right to earn sufficient to cover all costs incurred, including interest and depreciation on the *whole* of the investment. If, therefore, it is policy that the costs, including the capital costs, of providing transport services should normally be incurred only if there are reasonably good prospects of earning back revenue sufficient to cover them, then the question raised does not arise. This is not to deny, however, that such a policy does imply that the charges for and revenues from the services to be rendered may stand at levels well above opportunity costs proper for an indefinite period of time, an eventuality to which some would no doubt take exception. Suffice it to say here that there may well be circumstances in which a government or municipal authority may decide to shoulder the debt or part of a debt in the interests of cheaper transport in spite of the fact that the transport undertaking might be perfectly able to do so itself (the circumstances we are now considering). Such a choice is essentially a matter

of distribution. But there does seem to be an element of "rough justice" in placing this burden upon the users of the facilities provided. For not only are the latter enjoying the benefits accruing from the investment but are also showing themselves willing and able to pay for such benefits on a scale sufficient to meet all the current costs and past financial commitments involved. Those who prefer that whenever possible public corporations should be financially self-sufficient and separate from national or municipal budgets must inevitably take this view.

But it is the circumstance in which major investments have already taken place which have turned out, from a financial point of view, to have been unwise which calls for decisions of policy of so highly controversial a character. And it is to this last situation that we shall now turn our attention. Let us suppose that to whatever levels prices and services are adjusted, revenues are insufficient to meet original expectations, to the extent of the case illustrated in Tables I and II above. What should be the attitude of those responsible for overall transport policy towards such a situation? Only from a purely financial point of view are the services being run "at a loss." All economic costs are being covered. There is no threat to the public of the services being withdrawn.

It is clear that in essentially competitive conditions there would be no alternative to insolvency or bankruptcy, probably followed by a scheme of capital reconstruction. The burden of the "mistake" would inevitably fall upon those who took the risk—the investors. When, however, degrees of monopoly exist, or can be established (by law or otherwise), for the purpose of protecting the interests of investors against the full consequence of financial failure, it then becomes a matter of policy as to what, if anything, should be done about it. Historically, one can distinguish at least three different lines of action to which resort has been taken.

First, when the earnings of publicly owned tramways or railways have failed to earn sufficient to meet in full the financial commitments entered into in respect of such transport, the burden of failure has been taken over by the local authority or government concerned. In such cases the capital had been raised and repayment guaranteed by the authorities concerned. The ratepayers or taxpayers, having willingly (or unwillingly!) been put in the position of risk-bearers, and, having lost, have shouldered the burden. This would seem to be a natural and inevitable result of schemes of municipalisation or nationalisation which link the financial fortunes of transport undertakings with municipal or national finance. Compared with other methods of dealing with the situation, *it has the great merit of not interfering with the development of those newer and more preferred means of transport which were in many cases the cause of the financial failure itself.*

A second line of action has been the unashamed protection of the financially disappointing undertakings against the competition of the newer and more preferred forms of transport, by means of deliberately preventing the

unfettered development of the latter in response to public demand. The economic consequences of this second line of action, if successful, are clear. The financial results of the older form of transport are " improved " at the expense of all those additional members of the public who would have patronised and become employed by the newer forms, had the latter been permitted to develop unhampered and in response to technical advance and public demand only.

A third line of action which has been permitted, if not actually encouraged, over the last half century has been the acquisition or control of the newer forms of transport by the old, whereby the financial success of the newer form has been used as a means of relieving the financial embarrassments of the old. Again, if the plan succeeds, among those who gain are those whose financial interests lie with the older form of transport, whereas among the losers are those who are denied the fullest possible benefits, in terms of lower fares, better services and employment, of the new. For the new forms are being asked to earn more than what would have been required of them in the absence of the scheme of joint-ownership. Most schemes of " pooling " receipts are likely to have similar consequences.

Whereas the first of these three cases places the burden of the mistake upon the general body of tax or rate payers, the last two, by means of restraining (and/or postponing) the fullest possible development of the new forms of transport, throw the burden upon the would-be providers and users of those forms. That present policy (as opposed to what was normal practice in the inter-war period) is inclined towards the first of these alternatives is, in the writer's view, to be welcomed.

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# THEORY OF INCOME GENERATION AND ECONOMIC GROWTH[1]

THE purpose of this paper is to present a theory of equilibrium economic growth based on the process of when and how income is *generated* and how much of it is spent, in the aggregate, regardless of the fact whether it is spent on consumption or capital goods. The following model differs from the usual ones, where a distinction is made between capital and consumption goods, and which are based on how income is *spent* on these two categories of goods. We shall not make any such distinction and follow the procedure adopted by Professor Harrod.[2]

We define *outlays on investment* as all the expenditure that is made on circulating and fixed capital to bring into existence plants [3] that produce in a period the required quantity of capital goods as well as consumption goods. All the outlays on investment are expressed in net terms. This is to say that once a plant has been created, it will continue to produce the same amount of goods in each period till infinity. In the period of the creation of the plant the income generated will be equal to the expenditure made on all the circulating and fixed capital needed for it. In the following periods, however, the income generated by operating this plant will be equal only to the value of goods produced by it.[4] If we define fixed capital as items on which expenditure is made once for ever, and circulating capital as items on which expenditure will have to be made in each period to operate the fixed capital created, then the expenditure on circulating capital will be equal to the value of goods produced by the fixed capital in successive individual periods. In other words, expenditure on fixed capital is equal to the value added in the process of creating a plant, and expenditure on circulating capital is equal to the value added in the process of operating it.

We shall denote the total income generated in a period $t$ by $Y_t$. The effective demand in a period $t$, denoted by $X_t$, shall be assumed to form a constant proportion $\delta$ of the income generated in the preceding period, so that $X_t = \delta Y_{t-1}$. We shall denote the outlays on investment in period $t$ by $O_t$. The ratio between the outlays on investment and the value of

[1] I am grateful to Professor J. Tinbergen and members of the Division of Balanced International Growth, Netherlands Economic Institute, Rotterdam, for their valuable comments and suggestions for clarification in collective and individual discussions on this paper. Mr. L. B. M. Mennes also checked the solution of the equation and the table.

[2] R. F. Harrod, *Economic Essays* (London: Macmillan, 1952), pp. 258–9; and "Domar and Dynamic Economics," ECONOMIC JOURNAL, Vol. LXIX, September 1959, p. 460.

[3] "Plants" is used here in a comprehensive sense. It includes all the apparatuses and paraphernalia that are required to produce a certain amount of goods. "Plants" is related to all types of goods consumption as well as capital.

[4] This corresponds to Professor Oshima's "income originating effect." Cf. H. T. Oshima, "Income Originating in Models of Harrod and Domar," ECONOMIC JOURNAL, *op. cit.*, p. 445.

goods produced thereby in a period shall be assumed constant and equal to $\beta$. The value of $\delta$ cannot exceed unity;[1] and, in general, it cannot fall below 0·8 or so. The minimum value that $\beta$ can take is unity; it will equal unity in the case of existence of idle capacity, when the outlays on investment will equal expenditure on circulating capital only in order to operate the already existing idle fixed capital. The existence of such capacity is the characteristic feature of depressions, and in such periods $\beta$ may be small approaching unity. When there is no idle capacity the outlays on investment will include expenditure on both fixed and circulating capital, and then $\beta$ may rise up to 4–5 or even higher. In the following discussion we assume the prices to be constant and ignore all gestation lags. All other things which are not mentioned remain the same.

We start from a given amount of income $Y_0$ at the end of period 0. The effective demand in period 1 will be

$$X_1 = \delta Y_0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

As we are starting from scratch, meaning thereby that no production was carried out in period 0, the whole of $X_1$ value of goods will have to be produced by fresh outlays on investment. Hence the total outlays on investment in period 1,

$$O_1 = \beta X_1 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

$\beta X_1$ is the total income generated in period 1, for there is no productive plant possessed from period 0 whose operation can generate any more income. Hence:

$$Y_1 = \beta X_1 = \beta\delta Y_0 \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

The effective demand in period 2

$$X_2 = \delta Y_1 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Out of $X_2$, $X_1$ value of goods can be produced by the plants created in period 1, and while $X_1$ value of goods is being produced, the same amount of income is being generated. Hence investment outlays in period 2 will be made to produce an amount of goods equal in value to $X_2 - X_1$, so that

$$O_2 = \beta(X_2 - X_1) \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

The outlays on investment in period 2 will generate an income equal to $O_2$. Hence the total income generated in period 2,

$$\begin{aligned} Y_2 &= O_2 + X_1 \\ &= \beta(X_2 - X_1) + X_1 \quad . \quad . \quad . \quad . \quad . \quad (6) \end{aligned}$$

[1] It may be contended that $\delta$ may exceed unity in some period, through dishoarding. This contention is obviously irrelevant in the long run. In any case, excess spending over that given by $\delta = 1$ should be treated as autonomous.

Proceeding in the same manner, we can write down the income generated in period $t$.

$$Y_t = O_t + X_{t-1}$$
$$= \beta(X_t - X_{t-1}) + X_{t-1} \quad . \quad . \quad . \quad . \quad . \quad (7)$$ [1]

The right-hand side of equation (7) consists of two elements; the first, $O_t$, is the total outlay on investment in period $t$ which is equal to $\beta$ times the excess of effective demand of period $t$ over that of period $t-1$, and the second, $X_{t-1}$, is the effective demand of period $t-1$ and is equal to the value of goods produced and the corresponding income generated by all the plants created till the end of period $t-1$.

In other words, $X_{t-1}$ is the value added in the process of operating in period $t$, all the plants created till the end of period $t-1$ (or till the beginning of period $t$), and $O_t$ is the value added in period $t$ in the process of creating and operating the plants created in period $t$.

Substituting $X_t = \delta Y_{t-1}$ in equation (7), we have the fundamental equation of income generation

$$Y_t = \beta\delta Y_{t-1} + \delta(1-\beta)Y_{t-2} \quad . \quad . \quad . \quad . \quad (8)$$

equation (8) is a linear homogeneous difference equation of second order; the initial values are $Y_0$ and $Y_1 = \beta\delta Y_0$.[2]

The following table gives the values of national income for selected values of $\delta$ and $\beta$ over 10 periods, initial income being 100 units of money.

TABLE I

Formula: $Y_t = \beta\delta Y_{t-1} + \delta(1-\beta)Y_{t-2}$; $Y_0 = 100$

| $t$ | $\delta = 1$ $\beta = 1$ | $\delta = 1$ $\beta = 3$ | $\delta = 0{\cdot}8$ $\beta = 1{\cdot}2$ | $\delta = 1$ $\beta = 2$ | $\delta = 0{\cdot}9$ $\beta = 2{\cdot}9$ | $\delta = 0{\cdot}9$ $\beta = 1{\cdot}5$ | $\delta = 0{\cdot}8$ $\beta = 2{\cdot}5$ | $\delta = 0{\cdot}9$ $\beta = 2{\cdot}1$ | $\delta = 0{\cdot}8$ $\beta = 1{\cdot}6$ |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| 0 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1 | 100 | 300 | 96 | 200 | 261 | 135 | 200 | 189 | 128 |
| 2 | 100 | 700 | 76 | 300 | 510 | 137 | 280 | 258 | 116 |
| 3 | 100 | 1,500 | 58 | 400 | 885 | 124 | 320 | 301 | 87 |
| 4 | 100 | 3,100 | 44 | 500 | 1,438 | 106 | 304 | 313 | 56 |
| 5 | 100 | 6,300 | 33 | 600 | 2,240 | 87 | 224 | 293 | 30 |
| 6 | 100 | 12,700 | 25 | 700 | 3,387 | 70 | 83 | 244 | 12 |
| 7 | 100 | 25,500 | 19 | 800 | 5,010 | 53 | −103 | 171 | 1 |
| 8 | 100 | 51,100 | 14 | 900 | 7,284 | 40 | −306 | 52 | −4 |
| 9 | 100 | 102,300 | 10 | 1,000 | 10,444 | 32 | −488 | − 15 | −6 |
| 10 | 100 | 204,700 | 7 | 1,100 | 14,803 | 23 | −609 | −110 | −6 |

[1] The equation $Y_t = O_t + X_{t-1}$ should not be confused with Keynesian identity $Y_t = I_t + C_t$. The former is based on how income is generated and the latter on how it is spent. In the former $O_t$ relates to both capital and consumption goods, so does $X_{t-1}$. See Harrod, *op. cit.*

[2] The solution of (8) can be written

$$Y_t = \frac{Y_0}{\sqrt{(\beta\delta)^2 + 4\delta(1-\beta)}}\left[\left\{\frac{\beta\delta + \sqrt{(\beta\delta)^2 + 4\delta(1-\beta)}}{2}\right\}^{t+1} - \left\{\frac{\beta\delta - \sqrt{(\beta\delta)^2 + 4\delta(1-\beta)}}{2}\right\}^{t+1}\right]$$

The table shows that the national income is constant in col. (1), steadily explosive in cols. (2) and (5), steadily declining in cols. (3) and (6), steadily increasing in col. (4), oscillating (assuming positive and negative values) with amplitudes increasing in col. (7), with amplitudes declining in col. (9) and with amplitudes tending to be regular and constant in col. (8).

The trends in cols. 7–9 are not clear, as 10 periods are too few to show them.

Equation (8) can be written as

$$Y_t - \beta\delta Y_{t-1} - \delta(1-\beta)Y_{t-2} = 0 \quad . \quad . \quad . \quad . \quad . \quad (9)$$

As equation (9) is a linear homogeneous difference equation of second order, we try $Y_t = \lambda^t$ to get[1]

$$\lambda^2 - \beta\delta\lambda - \delta(1-\beta) = 0 \quad . \quad . \quad . \quad . \quad (10)$$

$$\therefore \quad \lambda_1 = \tfrac{1}{2}(\beta\delta + \sqrt{(\beta\delta)^2 + 4\delta(1-\beta)})$$

and

$$\lambda_2 = \tfrac{1}{2}(\beta\delta - \sqrt{(\beta\delta)^2 + 4\delta(1-\beta)}) \quad . \quad . \quad . \quad (11)$$

The roots, $\lambda_1$ and $\lambda_2$, may be real and different when $(\beta\delta)^2 + 4\delta(1-\beta) > 0$, real and equal when $(\beta\delta)^2 + 4\delta(1-\beta) = 0$ or conjugate complex when $(\beta\delta)^2 + 4\delta(1-\beta) < 0$.

Case I: $(\beta\delta)^2 + 4\delta(1-\beta) > 0$

In this case the roots of (9) are real and different. The general solution is then:

$$Y_t = A_1\lambda_1^t + A_2\lambda_2^t \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)$$

where $A_1$ and $A_2$ are arbitrary constants which can be found in terms of initial values $Y_0$ and $Y_1$. The right-hand side has two terms $A_1\lambda_1^t$ and $A_2\lambda_2^t$. Each term can be explosive or damped. The value of $Y_t$ will depend on the dominant root and the corresponding dominant term. From (11) it is obvious that $\lambda_1$ is the dominant root and $A_1\lambda_1$ is the dominant term. We have, therefore, for large $t$'s

$$Y_t \text{ grows explosively if } \lambda_1 > 1 \quad . \quad . \quad . \quad . \quad . \quad (13)$$

$$Y_t \text{ is damped towards zero if } \lambda_1 < 1 \quad . \quad . \quad . \quad (14)$$

In the table equation (13) is represented by col. (2) and equation (14) is depicted by col. (3).

Case II: $(\beta\delta)^2 + 4\delta(1-\beta) = 0$

In this case

$$\lambda_1 = \lambda_2 = \frac{\beta\delta}{2} \quad . \quad . \quad . \quad . \quad . \quad . \quad (15)$$

[1] In the solution of equation (9) we have followed R. G. D. Allen, *Mathematical Economics* (London: Macmillan, 1956), pp. 187–90.

The solution of equation (9) now is [1]

$$Y_t = (A_1 + A_2 t)\left(\frac{\beta\delta}{2}\right)^t \quad . \quad . \quad . \quad . \quad . \quad (16)$$

where $A_1$ and $A_2$ are arbitrary constants which can be determined in terms of initial values. Equation (16) shows that for large values of $t$ the right-hand side is swamped by $\left(\frac{\beta\delta}{2}\right)^t$. Hence

$$Y_t \text{ grows explosively if } \beta\delta > 2 \quad . \quad . \quad . \quad . \quad (17)$$

$$Y_t \text{ is damped to zero if } \beta\delta < 2 \quad . \quad . \quad . \quad . \quad (18)$$

The relative values of $\delta$ and $\beta$ which make this case relevant must satisfy $(\beta\delta)^2 + 4\delta(1 - \beta) = 0$. It is so if

$$\beta = \frac{2}{\delta}\{1 \pm \sqrt{1 - \delta}\} \quad . \quad . \quad . \quad . \quad . \quad (19)$$

Or if when

| | |
|---|---|
| $\delta = 1$ | $\beta = 2$ |
| $\delta = 0{\cdot}9$ | $\beta = 2{\cdot}9$ or $1{\cdot}5$ |

In the special case when $\delta = 1$ and $\beta = 2$, $\lambda_1 = \lambda_2 = 1$. In this case $Y_t$ grows steadily by equal amounts as shown in col. (4) of the table. When $\delta = 0{\cdot}9$, $\beta = 2{\cdot}9$ or $1{\cdot}5$. In case $\delta = 0{\cdot}9$, $\beta = 2{\cdot}9$, $\beta\delta > 2$ and it corresponds to equation (17), so that $Y_t$ grows explosively as shown in col. (5) of the table. In case $\delta = 0{\cdot}9$, $\beta = 1{\cdot}5$, $\beta\delta < 2$ and it corresponds to equation (18), so that $Y_t$ is damped to zero, as shown in col. (6) of the table.

Case III: $(\beta\delta)^2 + 4\delta(1 - \beta) < 0$

In this case the roots are conjugate complex. The general discrete solution is [1]

$$Y_t = Ar^t \cos(\theta t - \epsilon) \quad . \quad . \quad . \quad . \quad . \quad (20)$$

Equation (20) is the general sinusoidal function of an oscillatory form. The arbitrary constants $A$ and $\epsilon$ can be found from the initial values. The structural constants $r$ and $\theta$ are given by

$$r\cos\theta = \frac{\beta\delta}{2}; \; r\sin\theta = \tfrac{1}{2}\sqrt{-4\delta(1 - \beta) - (\beta\delta)^2}. \quad . \quad (21)$$

$$\therefore \; r = \sqrt{\delta(\beta - 1)} \quad \text{and} \quad \theta = \cos^{-1}\frac{\beta\delta}{2\sqrt{\delta(\beta - 1)}} \quad . \quad . \quad (22)$$

The amplitude and damping of the oscillation is given by $Ar^t$. $A$ defines the initial amplitude and

| | | |
|---|---|---|
| the amplitude grows if | $r > 1$ . . . . . | (23) |
| it declines if | $r < 1$ . . . . . | (24) |
| and is regular and constant if | $r = 1$ . . . . . | (25) |

[1] Allen, *op. cit.*

From (22) we can see

$$r \gtrless 1 \quad \text{if} \quad \delta \gtrless \frac{1}{\beta - 1} \qquad . \quad . \quad . \quad . \quad . \quad (26)$$

Subject to the condition of case III, and the limits of $\delta$ ($0{\cdot}8 \leqslant \delta \leqslant 1$) and $\beta$ ($\geqslant 1$) [1]

$r$ is definitely greater than one when $\beta > 2{\cdot}3$
$r$ may be equal to, less or greater than one when $2 < \beta < 2{\cdot}3$
$r$ is definitely less than one when $\beta < 2$

In the table col. (7) represents equation (23), col. (8), equation (25) and col. (9), equation (24).

The period of the oscillation is $\frac{2\pi}{\theta}$. Since $\theta$ lies between 0 and $\pi$, the period is at least 2 intervals of $t$. Unlike the amplitude, the period is fixed by the structure of the original equation; it does not change from one oscillation to another, as $t$ changes. The smaller the value of $\theta$, the longer the period.

The upshot of the present analysis is that there are numerous possibilities for the behaviour of income movement depending on the relative values of $\delta$ and $\beta$. We have briefly indicated only a few of them. National income may grow explosively, decline towards zero and oscillate with amplitudes rising, falling or becoming regular and constant. The interesting point is that all these possibilities exist even when we assume that the warranted rate coincides with the actual rate of growth, *i.e.*, when the producers and the entrepreneurs accurately estimate the volume of demand and all their undertakings are successful.

When we allow for a divergence implied in that of Professor Harrod's warranted and actual rates of growth the movement of income may assume still more numerous ways. In fact, Harrod's instability principle can be explained very clearly and effectively by the present analysis. Suppose, for example, that the producers and entrepreneurs overestimate the effective demand. Given $\beta$, they will make larger outlays on investment which will increase the national income higher than it would have been otherwise, and their optimism will be fully (or even more than fully) justified. This buoyant state may continue till the limitations set by the natural growth rate begin to be felt or some extraneous events shake the confidence of the producers and entrepreneurs and they begin to doubt their judgment.[2] The reverse will happen when the producers underestimate the effective demand. Thus the instability principle stressed by Professor Harrod is admirably supported by the theory presented here.

The theory has been presented here in its most essential and crudest form. A number of autonomous developments that do take place in the actual world have not been taken into account. Introduction of new

[1] When we assume a change in the limits of $\delta$ and $\beta$ the limits following will change.
[2] Professor Harrod has pointed out other important cases for the reversal of the trend (*op. cit.*).

techniques of production, openings of fresh markets and potential increase in effective demand, discovery of additional resources, state decision to increase national spending directly or indirectly, some spontaneous wave of optimism or pessimism on the part of entrepreneurs and people, etc., may change the course of income movement. Particularly, state fiscal policy, broadly interpreted, is nothing but a mechanism to keep the movement of income at the desired path.

A theoretical model is, after all, a highly idealised form of reality. The need for simplicity and clarity dictates that we should assume the basic parameters $\beta$ and $\delta$ to be constant. In the real world they are not so; on the contrary, they are ever changing. For example, the same area of land (say in India) can be irrigated either by digging wells, in which case $\beta$ will be slightly greater than one, or by gigantic multi-purpose projects, in which case $\beta$ will be many times larger. $\delta$ also changes with the state of the economy, or more correctly, with the state of the economy as the entrepreneurs and the people believe it to be. When we envisage changing parameters the possibilities of varying courses which the movement of income may take become infinitely large. It should be remembered, however, that the influences of changes in $\beta$ and $\delta$ on the movement of income may counteract each other.

The above discussion has an important bearing on the decision-making about the size of investment by various countries. In the traditional framework the most debatable point is what proportion of income should be spent on consumption and what on investment. For it is argued, in the light of $Y = C + I$, the more that is spent on consumption, the less remains for investment, and vice-versa. It is agreed, though, that the greater the proportion of investment in the current period, the greater will be the consumption possibilities in the future. But the limit is very often set by the Keynesian identity, in which the volumes of consumption and investment can be increased at the cost of each other. According to the present approach, this identity is not relevant and is replaced by an equation $Y_t = O_t + X_{t-1}$. In period $t$ the value of $X_{t-1}$ cannot be changed, but $O_t$ is open, and it can be raised or lowered, and $Y_t$ will correspondingly change. This is not to say that $Y_t$ can be raised to any level at will. It is certainly not so. $O_t$ and, correspondingly, $Y_t$ can be raised to the limit at which the income generated in period $t$ can be sustained in period $t + 1$, $(t = 1, 2 \ldots \infty)$, with due allowance for $\delta$. In other words, the economy must be capable of making outlays on investment in period $t + 1$, equal to $\beta(X_{t-1} - X_t)$, given the value of $\beta$. This will obviously depend on the natural endowment of the country, energy, efficiency and the will of the people, foreign assistance and international lending, etc., etc. Thus there takes place a major shift of emphasis from a static identity to a dynamic equation.

A word may be said also about the controversy on labour and capital-intensive methods of production to be adopted in the underdeveloped countries. It is, roughly speaking, argued that labour-intensive methods

will increase the consumption demand, and hence leave less for investment. The answer of the present theory is again different. According to it, labour-intensive methods are all right, if the increase in effective demand can be met by goods produced by *fresh* investment outlays in successive periods. Provided this condition is fulfilled, the natural course for a country would be to adopt the methods of production which employ relatively more of the factors which are in surplus supply.

These are only a few of the modifications in outlook that the present analysis suggests. There may be several other possibilities where this new approach may be helpful. A final remark may be made on the distinction between capital and consumption goods. Such a distinction has certainly an analytical convenience and pragmatic advantage. Such a division can be made in the present model too, if it is desired, by splitting each of $O_t$ and $X_{t-1}$ in two parts,[1] one representing capital goods and the other consumption. It is, however, felt that not much is lost by not making such a distinction. A trifling but stubborn fact of the present-day world is that the countries which are in short supply of capital goods are also in short supply of consumption goods. This shows that there is a large degree of interdependence and substitution between the two. Whatever that may be, capital and consumption goods have to be lumped together here for "the purpose of formulating the dynamic theorem in its most general possible form." The present approach is more comprehensive and realistic at least in one important respect. The usual models,[2] which are sensitive to changes in consumption only, cannot account for developments that are initiated by changes in the demand for capital goods (to start with). This may happen (as it often does in the real world) just owing to changes in the state of entrepreneurs' psychology distantly related, perhaps, to some favourable or unfavourable turn of events that may or may not take place, not to speak of many state controlled projects (mostly intended for producing capital goods) which have become so common these days. The present model covers also such developments, which are initiated by changes in the demand not for consumption but for capital goods.

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[1] The proportion of capital and consumption in $X_{t-1}$ in period $t$ is fixed, but it is variable in $O_t$ according to the pattern of effective demand and the techniques that are intended to be employed. It must be stated here that $Y = C + I$, interpreted correctly, is not limitational. But being just an identity, it is not operational. The error is committed when it is consciously or unconsciously used operationally.

[2] Cf., in particular, Paul A. Samuelson, "Interaction between the Multiplier Analysis and the Principle of Acceleration," *Review of Economic Statistics*, Vol. XXI, May 1939. There is some apparent similarity between the equation contained in this paper and that of Samuelson but the two are essentially different based on different premises and reasoning.

# REVIEWS

*Capital, Interest and Profits.* By B. S. Keirstead. (Oxford: Basil Blackwell 1959. Pp. viii + 171. 22*s.* 6*d.*)

It is difficult even nowadays to realise how deeply economic theory has lain under the spell of classical (physical) mechanics and its appropriate mathematical ways of thinking, and has accepted calculable nature as a model of human affairs. The almost perfect predictability of celestial events, the stability of the planetary movements depending on a balance of forces, the subtle power and mystery of the differential calculus (as the old view saw it), needed only the notion of "marginalism" to make plain the relevance of these things to economics, and show the immense and all-embracing scope of an explanatory system which could be constructed on the lines thus suggested. I cannot think that such a picture of the emergence of the general equilibrium idea is altogether fanciful. Nor would any detached thinker dream of denying its character of genius. So much explained, so universal a filing system for every possible question, so great a generalness of the answers, so sweeping and magnificent a scope, so simple and beautiful an essential basis; all these compelling glories of the general equilibrium conception gave it its deserved authority and, until thirty years ago, made questioning of its sufficiency almost disgraceful.

The question since then, in face of the catastrophes of the 'thirties, has been whether to abandon it and start afresh (such a thing, is, of course, always impossible, but we sometimes think it must be attempted) or whether to seek to transform it so that the grossly unmanageable questions, such as massive unemployment and great fluctuations, can be brought within its scope. By Keynes' great *tour de force* it was made to seem that the old tools would do, used differently. The static frame, the marginal equalisations, all the Marshallian apparatus of analysis were retained, only some parts of the machine were released from their dependence on others, and thus disconcerting things were enabled to happen in the Keynesian model which the Marshallian machine did not allow. Keynes built with the tools he had been given. He played upon an old instrument, and produced the sounds of a new one. Virtuosity carried to an extreme achieved the *General Theory*. Then the War came and stopped the debate.

Afterwards, when economic theoreticians had recovered their breath and taken their noses away from the grindstone of day-to-day necessity, some wanted to show that Keynes need not have bothered: the old instrument could play all the necessary (or at least, all the *desirable*) tunes; some wanted an entirely new instrument to play econometric tunes, or theory of games tunes. Only one or two have wanted to complete the Keynesian task itself,

to replace the *General Theory* with a model which should go the whole hog in those directions which Keynes pointed out. Amongst these few, Professor Keirstead wears the Marshallian and Keynesian mantle with high distinction.

He has carried to its logical conclusion the Keynesian principle of release, of admitting the dominant influence, in the working of the economy, of those loose ends which are held by politicians, by inventors, by Schumpeterian innovators, by Madison Avenue and by the electorate itself. Keynes freed *investment* from its theoretic dependence on the gradual exhaustion of a given stock of technical "investment opportunities," or on the accelerator, or what not, and stood it up on its own autonomous feet, with only expectations whispering in its ear. Professor Keirstead has similarly released the interest-rate from its dependence on the feelings and desires of individuals and made it a primarily political entity. How obviously, in these times, it is just that.

His book carries the debate of the 'thirties towards completion in another sense. That debate was a many-sided affair, involving theories of money, of capital or investment, of employment and of the process of change in an economy. It began, perhaps, with Sir Dennis Robertson's *Banking Policy and the Price Level* in 1926. Just at this time (the year of Wicksell's death) the new Swedish School of Lindahl and Myrdal, unheard of in England, was getting into its stride, producing a radically new economics of expectation and successive differing equilibria. While the Swedes were transforming Wicksell, Hayek in Vienna was transforming Böhm-Bawerk and showing that not only the amount, not only the speed of growth, but also the *structure* of capital (equipment) mattered. A few years later, Hicks sitting as it were on the shore watching the incoming Keynesian flood did not quite prevent it from erasing Hayek's ideas from men's minds. It was a pity, for even to-day, the Cambridge- and Oxford-School (Hicks apart) do not fully understand the importance and high topical relevance of what Hayek was saying in 1931. What are the right kinds of equipment to build first, in an underdeveloped country? How can the developers know how ambitious or cautious to be in their plans? What will happen if they are too much in a hurry? How harshly authoritarian must a Government be, to drive a primitive country into the effort and sacrifice needed to get it off the ground into sustained growth of wealth? Into the ultimate basis for answering these questions Hayek had a profound vision which he failed to convey. *Prices and Production* was fearfully confusing, even perhaps confused, but it had a germ which now, in Professor Keirstead's hands, has been shown to be fruitful. Professor Keirstead mentions, too, the name of a Hayekian whose penetrating work in this field has been too little recognised, Professor L. M. Lachmann.

The Austrians and Irving Fisher considered that interest is the reward of consuming, during some interval, less than one has the power to do. But saving is done, either by those with very large incomes who already consume everything they have a mind to, and who save a large part of their incomes

because they have no unsatisfied needs for consumption, or else by those who, being members of an impotent crowd of unorganised shareholders, or of a still larger crowd of still more helpless taxpayers, save willy nilly that part of their incomes which is never placed in their hands to do anything else with. Or finally, saving is done by those upon whom capital losses are imposed by State-generated inflation, their money depreciating while they wait to spend it. The case is strong, and Professor Keirstead does well to make it, he is justified even in that slight exaggeration which a neglected view requires if it is to be drummed successfully into ears pre-empted by other theories.

Nonetheless, interest is paid for something, and necessarily for something scarce. For what? Professor Keirstead appears to treat "free capital" as something whose available quantity is the rather arbitrary or accidental upshot of a complex of forces and purposes primarily directed towards non-economic or only semi-economic ends. Interest, it therefore seems (Professor Keirstead does not say so) is a kind of rent, arising from the competition of entrepreneurs for the use of a resource whose total quantity does not respond to changes of its price. Nevertheless, there is no exact equalisation of a precisely measurable "marginal efficiency of capital" and the interest rate payable for loans. The appeal to such a tendency, the desire for such clear-cut, simple theoretic precision is, we may think, a consequence or vestige of Keynes' training in *orthodox* maximisation economics, wherein maximisation was synonymous with the equating of a derivative or differential to zero. For his generation and even for later ones, economic theory worked in terms of continuity, divisibility and the calculus. Professor Keirstead points the need for something looser-jointed, dealing (we may venture to interpret him) in inequalities, a theory in which the comparanda are discrete, technically crystallised, masses or plans or policies, call them what we will. The motive for investment is profit, and profit is not "the marginal efficiency of capital," it is not something that can be looked up in the Stock Exchange list or worked out on a computer, it is a hope, a figment, powerful but undemonstrable, and only by convention reducible to arithmetic.

Let us be just to Keynes. He, if anyone, was fully seized of this problem. He was the first to give it emphasis, and he stated it in the final capstone of all his work on the theory of employment, his article called "The General Theory of Employment" in the *Quarterly Journal of Economics*. But this solution was to regard the *schedule* of the marginal efficiency of capital as highly unstable, capable of sweeping up and down abruptly through a great range, and thus of *representing* those strong tides of sentiment that characterise the inducement to invest.

In the second half of his book Professor Keirstead draws upon a rich historical and geographical erudition to illustrate his theory of the necessary and sufficient conditions for the transformation of a technically stagnant or "conventional" society into a progressive and capital-accumulating one.

His case histories, especially that of Newfoundland, of which he has such intimate knowledge, give the practical problem of capital a desperate realism and poignancy which explain the author's change of style between the two halves of his book: the first urbane, detached and abstract despite the author's business knowledge, the second passionate and alive with a savage wit.

It is a fact to which we, as economic theoreticians, do not give sufficient thought, that the greater part of modern economics is founded upon a theory, the theory of maximisation, marginalism and equilibrium, which was contrived in the most orderly and tranquil period of one of the most orderly and tranquil societies the world has ever known, that of Victorian middle-class England and certain countries of the Continent in the generation after 1870. Even to-day, after the wars, revolutions, purges and depressions, the inflations, menaces and cynical political criminality of fifty years, we still base ourselves ultimately on the perfectly competitive, rational and calculable Victorian model. This fact need not surprise us. It is useless and impossible to throw overboard the thoughts ingrained in us by the literature of our subject, we can only change them by stages from within. Of this process Professor Keirstead has given us a deeply persuasive example.

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*The Growth of British Industrial Relations. A Study from the Standpoint of 1906–14.* By E. H. Phelps Brown. (London: Macmillan, 1959. Pp. xxxvii + 391. 42*s*.)

The scope of Professor Phelps Brown's book can best be seen from the chapter headings: Chapter I is entitled "The Condition of the People"; Chapter II, "The Conditions of Work"; Chapter III, "The Development of Industrial Relations"; Chapter IV, "The Development of Public Policy"; Chapter V, "Institutions and Procedures in 1906"; Chapter VI, "Strife, 1906–14"; Chapter VII, "Sequel and Survey." The work is rounded off by a series of very brief biographical notes on about 125 of the principal *dramatis personæ*; a useful Appendix on sources; and an excellent index.

Although the study is chiefly focused on the period from 1906 to 1914, the author inevitably has to deal at some length also with the events and trends of the twenty years prior to 1906. Throughout, Professor Phelps Brown draws on his wide knowledge of the available statistical data; and the interest of his work is much enhanced by his ability to express many aspects of his material in quantitative terms.

His judgments are forthright, if perhaps occasionally somewhat surprising: he rarely (except when actually quoting) refers to his sources; so the reader has

to take a good deal on trust, since he has no means of assessing the weight of the evidence on which the statements are based. Some of them indeed seem to depend upon a certain amount of hind-sight; and it is possible that a more appropriate sub-title would have run: "A Study of the Period 1906–14 from the Standpoint of 1959." One small detail, where 1959 should have served the writer better, is that having defined full employment as being "attained when the rate of unemployment is below three per cent," he applies this term to certain phases of the trade cycle in the second half of the nineteenth century and to particular years, *e.g.*, 1889, without mentioning that this percentage figure is taken from the trade-union returns which were virtually confined to skilled men. Moreover, he himself points out elsewhere that: "The unskilled man was under-employed at the best of times. He worked on short engagements and there were gaps between them. The sort of work he did fluctuated from day to day and the fluctuations were thrown on him." Surely the use of some other term, such as "maximum employment," would have been preferable; or at the least the words "full employment" placed in inverted commas to show that the term is being used in a very special sense.

Taken as a whole, the book represents a notable achievement: it is clearly based on very extensive research, and it is extremely well written. The present reviewer has found it fascinating reading: it has renewed for him many half-forgotten memories of the years immediately before the outbreak of the 1914–18 war; and, particularly in Chapter VI, "Strife, 1906–14," it throws a vivid light on the domestic anxieties which darkened the horizon of those last years of international peace.

Everyone interested in current industrial relations should read this book for the insight it will give him into their historical background, and for the realisation it affords of the continuity of so much that might otherwise appear to be peculiar to our own times.

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*Histoire des Théories Économiques Spatiales.* By CLAUD PONSARD. (Paris: Librarie Armand Colin, 1959. Pp. 202.)

SPATIAL economics has recently followed economic dynamics in emerging as a separate, even if still incomplete, branch of economic theory. A history of its evolution is therefore most welcome to-day, particularly if written by an author who demonstrated in his *Économie et Espace* (1955) his impartiality towards the various schools. As spatial economic theories require a high degree of abstraction, many students also may prefer this historical approach, which traces the lines of development from author to author, to a more comprehensive direct treatment of the whole subject.

The high degree of abstraction assists in explaining the slow evolution of these theories. Although many mercantilist and physiocrat writers were concerned with the effect of space on the structure of the economy, Thünen (1826) was the first to formulate the basic problems of spatial economy (town and country relations, spatial price formation, distance and production relations with the associated problems of rents and incomes), and thus produced his famous circular pattern of supply–demand relationships. M. Ponsard regards Thünen, despite his intellectual isolation in Germany, as the heir of much eighteenth-century thought. For this reason, some of the earlier work, especially that of Cantillon (1755), is evaluated. Indeed, these contributions, although not systematic, are quite outstanding in forecasting both modern regional theories as well as conditions of spatial equilibrium. As M. Ponsard's work is focused on Thünen and his successors, the discussion of the earlier works is not complete and, for example, the important work of Sir James Steuart (1767) is not mentioned.

M. Ponsard stresses that, due to the impact of Ricardo's ideas on differentials in the fertility of land, Thünen's concepts of space did not receive much attention in the following century. Despite the growing significance of overseas trade, neither English-speaking (for example, Marshall) nor French writers considered problems of space systematically, and thus spatial economics remained virtually a German monopoly. Even there, progress was slow. Weber (1909) added weight analysis, and thus prepared the way both for gravity models and considerations of spatial equilibrium. However, his assumptions on elasticities of demand and supply and on the location of labour and demand (pre-determined) were unsatisfactory. Despite these defects, M. Ponsard notes that Weber's ideas still hold some attraction for countries that desire forms of autarkic industrial development, such as India. However, he does not refer to the interesting controversy on Weber's theory contained in S. S. Balzak's *Economic Geography of the U.S.S.R.*

Predoehl (1926) added marginal substitution concepts of these theories. American and British authors (Fetter, 1931; Chamberlin, 1933; Robinson, 1931; Lerner and Singer, 1937; etc.) are shown to have made quite independently spatial economic observations in investigations of monopoly. Again independently, but partly influenced by Thünen, Ohlin (Sweden, 1933) contributed from international trade theory. These various threads, as well as the earlier work of Launhardt (1882, a reciprocal of Thünen's circles resulting in definitions of market areas), are taken up by Palander (Sweden, 1935), who was thus able to consider the spatial effect of markets. However, his theories based on Weber's puncteoform location of production remained very incomplete. Loesch (Germany, 1940) overcame some of these difficulties with his theories of regions (incorporating differences between agricultural and industrial distributions, hexagonal patterns of spatial organisations, significance of boundaries) and trade, and thus arrived at a scheme of spatial equilibrium. To achieve this Loesch had to adopt an

extreme rigidity in his exposition. This M. Ponsard regards quite rightly as premature in view of the limited material available. For this reason, Loesch's work is a substantial progress report rather than a definite work on spatial economy. As progress since then has been limited to mathematical contributions (Beckmann, 1950) and applications of modern economic analysis (Isard, 1956; described as the main intellectual heir of Loesch), Loesch's work still remains the most comprehensive presentation of spatial theory.

Despite thorough references to German literature, M. Ponsard does not mention the work of Christeller (1933), who pioneered in the discovery of hexagonal patterns of spatial organisations and hierarchies. These and other defects are, however, of minor significance. The work describes admirably the evolution and integration of a complex body of theory. An English translation of benefit to the growing number of students of spatial economics is recommended. The book also contains a good mathematical appendix and a useful chronological bibliography.

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*A Textbook of Money.* By S. KORTEWEG and F. A. G. KEESING. (London: Longmans, 1959. Pp. xx + 308. 35*s.*)

*The Economics of Money.* By A. C. L. DAY. (London: Oxford University Press, 1959. Pp. vii + 248. 7*s.* 6*d.*)

MERCIFULLY for the reviewer these two text-books are not quite on the same subject, in spite of a minimal differentiation of title. Mr. Day's, which is an introductory version of his *Outline of Monetary Economics*, covers the field of macro-economic theory with only a little banking thrown in. On the other hand, the book of the two Dutch authors, who are here offering us a translation of the seventh Dutch edition of their work, is concerned far more with the institutions and practices of the monetary superstructure and how these lubricate, clog or thrust the capitalist economy. Old acquaintances, such as Gresham's law, $MV = PT$ and purchasing-power parity, occupy a moderately prominent place in the Dutch offering—dressed, where necessary, to conform with more recent fashions—but are entirely excluded by Mr. Day, who, *per contra*, leaves money out even from the trade cycle, confining himself in this matter to recounting the marriage of the multiplier and accelerator which Samuelson promoted and Hicks endowed with floor and ceiling.

Methodologically too the approaches are different. Mr. Day adheres strictly to comparative statics. Except in the chapter on the trade cycle, his model moves from one plateau to another in response to selected disturbances. Professors Korteweg and Keesing, on the other hand, consider that the *raison d'être* of monetary economics as a separate branch of study lies

in the fact that the system does not settle down to any equilibrium. Consequently, their model is in perpetual motion. It is doubtless largely due to Mr. Day's skill that his work is of a tighter, neater construction, imparting a clear idea of cause and effect and laying the foundations of disciplined thinking. But in some part, it is perhaps also due to greater familiarity with and the easier handling properties of a static model—which is a reason why we should make allowances for those who tread a less familiar but ultimately more promising path.

With remarkable self-effacement the Dutch authors attach no preface to their book, so we have to fall back on the blurb for a statement of intent. From this we gather that their claim to a niche in the overcrowded library shelf labelled "monetary text-books" rests on their elucidation of the "practical complexities" of money, as distinct from the esoteric disputations about it. If this means that they offer a more detailed description of the mechanics of monetary operations and give greater prominence to the technical specifications of the monetary machine than is usual in a general text-book addressed to the uninitiated, the claim is well founded. From routine rules, designed to adjust the circulation of notes and coin in such a way that parking meters, say, do not cause a scarcity of sixpences, to the complexities of exchange control, a vast range of technical matter is covered. The range under the heading of payments restrictions is particularly wide, including such things as Schachtian clearing agreements and multiple exchange-rate practices. This is a valuable feature of the book which is enhanced by the fact that the practices described are invariably shown to have consequences which are fit objects for economic analysis. But as the authors take the world as their province, they occasionally give the wrong impression about practices in Britain. Here is an example at the trivial level: "In a bank's balance sheet cash and call money are normally lumped together" (p. 23). More serious is the absence of any reference to liquidity ratios or to open-market operations in other than bills. What is trivial and what is serious will, of course, differ from one part to another of the English-speaking market towards which this translation is aimed.

In the light of Radcliffe controversies, the Dutch authors' distinction between credit operations of banks and those of other financial institutions bears quoting: "A credit operation will expand the volume of money, if the amount obtained by the borrower does not reduce anybody else's purchasing power" (p. 33). Not that these issues are consciously ventilated in the book.

Neglecting differences of opinion and of interpretation with the two authors, attention may be drawn to one—as far as it could be ascertained, the only one—outright fallacy. It is illustrated in the following passage: "The increase of M that occurs in that case [full employment] will raise prices and thereby reduce [real?] spending, thus restoring the *ex post* equality between national income and expenditure" (p. 90). This talk of restoring an identity reflects a confusion between *ex post* identity and *ex ante* equilibrium

which crops up in a number of contexts but miraculously turns out to be a virtually harmless lapse. In the region of doubt between fallacy, odd definition and misprint falls the equation on p. 49, which makes *MV* equal to factor payments plus expenditure on final goods.

The translator is anonymous. On the whole he has done a very competent job. A few things which sound strange do nevertheless occur. ". . . inflation will be deemed to exist when there occurs an increase in MV that is not caused by a growing number of stages of production" (p. 91) may mean something in Dutch, but what does it mean in English? Again, "commodities whose absence does not appreciably upset economic planning are called non-essentials" (p. 211) may sound less pedantically earnest in the original. Or perhaps these specimens are just as bad in any language and should not be laid at the translator's door.

How Mr. Day's book will read in a Dutch translation is anybody's guess. In English, it reads so well that it will establish Mr. Day as an introductory expositor of a high order. A book designed for the most elementary level inevitably involves drastic selection and painful compromises. Not everyone will agree with Mr. Day's judgment in every instance. This reviewer would be inclined to warn students to whom he recommends the book that the reconciliation of conflicting economic objectives and interests is not as easy as Mr. Day makes it appear. If, to take but one example, growth had been included among the objectives, the effect would have been less soothing but more salutary. The main point, however, is that the book can be recommended unhesitatingly as an excellent first introduction to Keynesian economics.

Chapter Nine is on a rather different plane of discourse from the rest. There Mr. Day argues why a "bills only" approach to open-market operations, a cash ratio convention and an unlimited commitment of the central bank to discount bills at bank rate cannot be expected between them to have any effect on bank deposits except through the change in the structure and level of interest rates, or in so far as the bills are sold to or purchased from holders outside the banking system. That this should have dawned so late in many quarters is indeed surprising, and it is no doubt Mr. Day's justification for changing the level of the argument in the middle chapter of the book. But Professors Korteweg and Keesing, at any rate, do not give the impression of ever having been guilty of the fallacy that, with unlimited discounting at bank rate, open-market sales of bills force a contraction of bank deposits with a multiplier equal to the reciprocal of the cash ratio.

In conclusion two untypical oddities in Mr. Day's book. First, the line between "autonomous" and "accommodating" capital movements is drawn in such a way that all short-term movements come under the heading of "accommodating" (pp. 153–8). Second, the gold standard is said to have worked tolerably well in the pre-1914 days because price flexibility in traded goods was greater thanks to the fact that a greater proportion of total

international trade was in primary products (p. 204). (Were the elasticities commonly associated with primary products different in those days?)

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*Economia Internazionale.* By GIUSEPPE UGO PAPI. (Turin: Unione Tipografico–Editrice Torinese, 1959. Pp. 524. Lire 4,500.)

THIS book is one of a recently planned series of major works by Italian economists on different aspects of economics. Although Professor Papi's weighty volume is entitled International Economics, its contents range over a widely different field from that covered by most works with a somewhat similar title.

The first 280 pages are devoted to general topics, such as the basic factors which make for economic growth; the causation of economic fluctuations; the measures that can be adopted for securing greater stability. These matters are dealt with more on national than on international lines, although the interdependence of countries is stressed throughout. In the course of his discussion of economic fluctuations Professor Papi engages in some rather shadow boxing with Keynesian theories, on the lines of the controversies of the late 1930s, the dust of which it might have been hoped would be laid by now. However, it is clear that his main preoccupation is with the perversions to which Keynesian doctrines have been subjected in countries where productivity and the economic utilisation of resources are sacrificed on the altar of "full employment."

With regard to theory, Professor Papi is very much a classical economist: it is with the underlying long run principles of economics that he is primarily concerned. His classicism is, however, tempered by his insistence on the immense importance of the role of the State in economic systems to-day. While, on the one hand, his treatment may often give the appearance of being elementary—he certainly, for example, leaves out of account the recent work which has been done in this country and elsewhere on the theory of growth —on the other, what he has set out to do is to concentrate on fundamentals; and, as Marshall showed long ago, statements which appear to be simple and straightforward may none the less be profound. In addition to a long working life as a writer and teacher of economics, Professor Papi, who is Rector of the University of Rome, holds an important post in the Italian Ministry of Agriculture, and for many years has been consulted by his Government on matters of general economic policy. His views command respect (even if not invariably acceptance), since they represent the outcome of long-continued observance of economic events and active participation in large issues of policy.

In the second half of this large volume Professor Papi sets out at length

and in considerable detail the efforts which have been made in recent years in the direction of economic co-operation in Europe. Much space is devoted to the Common Market; and here he can speak with the authority of one who has himself taken a considerable part in the negotiations which led up to its formation. It would be difficult to find a more sober or realistic appraisal of the opportunities, but also of the hindrances and dangers, attendant on this imaginative and courageous adventure.

In writing this book Professor Papi has deserved well of the cause which he himself has so much at heart—the unity of free Europe, with the object of achieving " greater prosperity and an enduring peace."

C. W. GUILLEBAUD

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*Social Accounting and Economic Models.* By RICHARD STONE and GIOVANNA CROFT-MURRAY. (London: Bowes & Bowes, 1959. Pp. 88. 9*s.* 6*d.*)

THIS slim volume may be conveniently described as a sum of A + B where A and B are pamphlets. A is a successor to that useful guide, Meade and Stone on *National Income and Expenditure*, which is somewhat too brief on social accounting. It is very desirable that the student should use the aggregates in the National Income Blue Books with a proper feeling for their inter-connections, and should in fact see them, not as elements in separate accounts, but as a description of an economic *system*. He will be helped to do this by the simple flow diagrams and accounts in Chapter I of pamphlet A, and by the idea of a " social accounting matrix " introduced and illustrated in Chapter II. From this he is led gently to the idea of input–output analysis. Pamphlet A is written in a style appropriate for the ordinary first- or second-year student, and the publishers would do well to consolidate it with the earlier work of Meade and Stone when this is next revised.

Pamphlet B, however, is addressed to a much more restricted readership —those who are interested in economic model-building and who can understand matrix algebra. It describes some simple models of production and of consumers' behaviour; the former are linked to the social-accounting ideas previously presented, while the chapter on consumer behaviour summarises some of the work for which Professor Stone and his collaborators are well known, and presents a selection of its practical results. The exposition is quite clear, but it is not light reading—perhaps in part because it does not use the skill of the typographer to guide the eye through the jungle of vectors and matrices; and it may well be thought that anyone capable of understanding the mathematics would wish to get it from more extensive primary sources. The chapter on models of consumer behaviour will, however, find a very useful place as a guide to some of the literature, and it

leads up to an interesting discussion of a "dynamic linear expenditure system," with an illustration from post-war United Kingdom data.

The puzzle remains: why should those who need A be forced to buy B? Why should those who want B have to buy A, which will probably be well known to them already? The "package deal" is not usually advantageous to the consumer. But in this case it may surely be said that it is a bumper package, offering two for the price of one.

C. F. CARTER

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*Problems of Capital Formation: Concepts, Measurement, and Controlling Factors. Studies in Income and Wealth, Volume Nineteen.* By the CONFERENCE ON RESEARCH IN INCOME AND WEALTH. (Princeton, New Jersey: Princeton University Press for the National Bureau of Economic Research (London: Oxford University Press, 1957. Pp. 609. 60*s*.).

THIS is a collection of fifteen papers presented at the Conference in October 1953, together with discussions. In the four years between the Conference and publication—too long even by the standards of this series—the best papers were circulated and lost the attraction of novelty; while some were published as parts of monographs and should be read in that form. (But the reviewer is to blame for the delay between the date of publication and the date of this review.)

The volume, as expected, displays the scale of American research in this field, with an obvious difference between detailed notes and points of general interest. Part I is on conceptual and statistical problems and contains, *inter alia*, an interesting essay on certain changes in accounting techniques during the last fifty years by G. O. May, the doyen of the profession. E. F. Denison's essay points to a fundamental difficulty in measuring capital which is due to quality change. For an economic theorist this is an important paper, as it emphasises the unsatisfactory nature of many of the estimates with reference to the requirements of economic theory.

Part II is devoted to the measurement of capital coefficients and capacity, and is of interest, since Western economists tend to rely, for want of anything else, on American coefficients, though many of them are based on shaky data. Anne P. Carter, F. T. Moore, R. T. Bowman, Almarin Phillips and J. E. Hodges deal with different industries. Even in a narrowly defined industry there are large differences in capital coefficients. Part of these differences can be explained by taking into account quality differences in the product, differences in scale of production or geographical differences, but part remains unexplained. While the detailed problems of measurement appear formidable, one cannot help feeling that the more economists study these problems empirically, the better will become the planning decisions of

industry and government. This part is concluded by a valuable essay by B. G. Hickman, in which he demonstrates the existence of a relationship between the level of utilisation and the rate of growth of capacity in some industries. He shows that capacity begins to grow long before it is fully utilised.

Part III contains papers on problems of inventory investment by Ruth P. Mack and F. Modigliani. These raise debating points rather than make important new contributions to the subject. The concluding paper by R. Eisner on interview and other survey techniques of investment behaviour is, however, comprehensive and thoughtful. It should help economists to interpret the results of surveys, and it should especially help in reconciling results obtained by different methods. There is even a possibility that by looking more carefully at the results of interviews the rate of interest may once again recover its status as a factor in investment decisions.

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*Pioneering in Industrial Research.* By Kendall Birr. (Washington D.C.: Public Affairs Press, 1957. Pp. 204. $4.50.)

In recent years the subject of industrial research and, in particular, its significance as a variable influencing economic progress, has attracted increasing attention from economists. For the most part, however, the literature so far published has been confined to the discussion of the wider aspects of the problem, such as the principles governing research and the conditions under which it is most likely to flourish. It is thus with considerable expectancy that one turns to Dr. Birr's book, which is virtually a case-study of the role which research and development have played in the twentieth-century history of one of America's largest firms, and the reputed pioneer of the modern research laboratory—the General Electric Company (G.E.C.). Here, of all places, one would surely expect to find a wealth of empirical evidence concerning the vicissitudes associated with the origin and development of a research programme, and an assessment of the economic variables upon which the success or failure of research depends.

Unfortunately, if the reader is seeking answers to questions of this kind he will be disappointed. Not that one can censure Dr. Birr for his comparative lack of interest in economic affairs, as he is writing primarily as an academic historian " with a special interest in the development of science and technology." In consequence, only here and there, recorded almost as *obiter dicta*, will those well grounded in the Carter and Williams approach to the subject matter find much of direct appeal to them: well over one-half of the book, for example, is taken up with descriptions of the more im-

portant technical discoveries of the laboratory and the personalities behind them.

This does not mean, however, that there is nothing of interest to the economist in this study. Chapter 1, for example, contains an admirable summary of the rise and present-day importance of industrial research in both the leading European countries and the United States. In Chapter 2, which deals specifically with the problems associated with the formation of the G.E.C. laboratory, there are some illuminating reflections concerning the policy of personnel recruitment. Apparently some forty-two of the sixty-five prominent members in the early days had Ph.D.s, of whom twenty-two were recruited from academic posts. Analytical ability, curiosity, imagination and receptiveness were the qualities most sought after in applicants, and by careful selection, the payment of good salaries and the provision of first-class research facilities, the research institution, under the leadership of Willis Whitney, an able young chemistry instructor from the Massachusetts Institute of Technology, soon acquired a nation-wide reputation. Between 1906 and 1918 the total numbers employed rose from 102 to 198, and by this latter date, with its basic policies and main lines of research decided, the laboratory was firmly established within both the life of the G.E.C. and the electrical equipment industry in general.

After the First World War the laboratory both consolidated its work on earlier discoveries, on light and X-rays, for example, and pioneered new lines of research, as in metallurgy and chemistry. Employment continued to rise and reached a peak of 555 in 1929. The depression necessitated some cuts in staff, but on the whole, save that perhaps rather more attention was concentrated upon projects likely to yield quick returns, the work of the laboratory continued unimpeded. At no time was the national importance of the laboratory more clearly demonstrated than during the Second World War. Even by 1941, over one-half of its staff were engaged upon defence projects, and many and varied were its contributions towards the winning of peace. Since 1945 the laboratory has shared in the general expansion of research, and by 1956 it employed more than 1,300 people, of whom some 400 were professional scientists.

How far is it possible to assess the impact of the research laboratory either on the life of G.E.C. in particular or on that of United States industry in general? Dr. Birr does not shrink from admitting that though from every viewpoint the prosperity of the former has been marked and continuous during the past fifty years, it is virtually impossible to say how far such success can be attributed to the growth of its research and development facilities as such. But he is able to suggest four main reasons for the outstanding pioneering work which the laboratory has undertaken: first, the sympathetic support, unobtrusive guidance and solid financial backing of G.E.C.'s management; second, the exceptional quality of the laboratory's personnel and leadership; third, the sensible balance of the laboratory's

research programme between basic and applied research and the diversification of interests, as befits the needs of the electrical equipment industry; fourth, the ability of the parent company and its associates to exploit and commercialise promising inventions. "The research laboratory started an idea along the road but it was G.E.C.'s engineering skill, financial resources and marketing competence that created profitable lines of merchandise" (p. 182).

Based on documentary sources, which incidentally are extremely well annotated in a special appendix, Dr. Birr is to be congratulated for producing a very readable study. He is a lively writer, gifted with the ability—all too rare—of sustaining his readers' interest amidst a wealth of technical detail. As a purely descriptive history of the development of the G.E.C. research laboratory, its major contributions and the personalities behind them, there is little with which one can find fault. Indeed, it may seem a little ungracious for an economist to offer any criticism at all. Nevertheless, one cannot but feel a sense of disappointment that Dr. Birr did not allow himself to offer any kind of critical evaluation of his subject matter nor think it profitable to relate his findings to the wider interests of industry in general.

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*The Ministry of Labour and National Service.* By SIR GODFREY INCE. (London: Allen & Unwin, 1960. Pp. 215. 25*s*.)

SIR GODFREY INCE held the most important posts in the Department and is able to speak of them. He begins with the foundation of the Department in 1916. But even the Ministry was not self-created. The Board of Trade, with Sir William Beveridge, developed the Labour Exchanges Act in 1910; with a tentative form of unemployment insurance in 1912. In the Trade Boards Act, Mr. Mallon produced the reasons for Trade Boards; and Sir George Askwith was Chief Conciliation Officer in the Board of Trade. Sir George Askwith had established a semi-independent post as Chief Industrial Commissioner, and later the Ministry changed the old concept of the Conciliation Officers and placed those officials under the Regional Controllers.

The other matter which Sir Godfrey fails, I think, sufficiently to stress is the significance of Mr. Bevin as Minister of Labour. It was he who put the Department into the centre of Whitehall, especially during the Second World War. The International Labour Office was established in 1930. The Board of Trade had agreed that after it was created, its relations with the Government should be through the Ministry of Labour.

Sir Godfrey Ince, here, is emphatic on man-power. All persons, men or women, who were in employment, or could be caught into employment, either in industry, commerce, the professions or the Armed Forces became

the concern of the Ministry. In 1944, it is true, the Board of Trade took over questions of industrial policy and took from the Ministry the powers in connection with Special Areas and the development of Trading Estates. Against this, it is the Ministry who train unemployed workers in expanding industry or are responsible for the transfer of workers from one area to another.

In 1939 the National Service Act was passed and the Ministry took over the job of recruiting. Here the object of a Master Plan had been worked out and the Ministry decided on the distribution between the Armed Forces, Civil Defence and civilian war industries. Mr. Bevin, as Minister, directed that women should be given the option of going into the Armed Forces or directed to war work. Von Speer, the first director of man-power and industry under Hitler, said, after the conflict, that the United Kingdom had made a complete and magnificent call-up of its civilian labour, and he wished he had had the same fortune.

Mr. Bevin depended on the Lord President's Council, under Lord Waverley, which was the final arbiter for war, to hold the balance between work for the Forces and economic affairs. In due time, Mr. Bevin organised a Committee of the British Employers' Federation and the Trades Unions into a Council. All important matters of man-power and industrial relations went to the Council, which in most affairs reached an agreed policy. In time, Mr. Bevin, as Member of the Lord President's Council, was able to say " what industry could do and would do " to meet the frequent changes of the " load on industry."

This primary duty on the Ministry made the Department suitable for demobilisation and resettlement. Indeed, the plans for demobilisation, based on age and length of service, or special qualifications for work of National importance, was that of the Ministry. In time, the Ministry joined the Board of Education and the Ministry of Agriculture, opened a further Education and Training Scheme and created local Resettlement Advice Officers which could give special help, beyond the general question of the Employment Exchanges.

In May 1944 the Government announced their intention of maintaining a high and stable level of employment. It was under these auspices that the Ministry developed its training plans to fit labour for the expanding, and often highly skilled, employment; it also organised foreign workers and spare schemes for older workers at a time when the older worker was becoming an important factor in a man-power policy; and a special attack was made on the problems of men disabled during the War. An official Youth Employment Service was created, and in 1948 a report, drawn up by the Ministry, the Board of Education and the School Education Department devised the Youth Employment Service, which was incorporated in the Employment and Training Act. It is part of Sir Godfrey Ince's reputation that this report was called the Ince Report.

An Order of 1940 making strikes and lock-outs illegal and demanding

compulsory arbitration was revoked in 1951. At some stage also, the Industrial Relations Officers were placed under the Regional Controllers of the Ministry. It may have been thought that a local settlement was more possible with officers who knew the employers and trade-union officials. This doctrine differed from that under Sir George Askwith's job—he had special Conciliation Officers who were "Expert" in their functions. The next step in the Ministry of Labour was the transfer to them of the Factory Department from the Home Office. Finally, the Department took on the responsibility of the International Labour Office, which included Labour Attachés to the large Embassies. The I.L.O., set up in the Versailles Treaty, survived the Second World War and has been associated, as a Special Agency, with the United Nations.

Sir Godfrey Ince gives special attention to the place of the Employment Exchanges in "employment policy." Their service has been a major test, for their continued existence depended upon their success, and the assistance given to employers, to agriculture and to local trade-union officials is freely supplied. Persons claiming an unemployment benefit must sign on at an Exchange, but many who are seeking work can find the prospects at the Exchange. It is significant that an Exchange, submitting labour for a vacancy, must do so, irrespective of race, colour, sex or belief.

The arrangements for dealing with higher appointments are not complete, for there are many professions and many industries which have a recruitment officer for jobs which are claimed to be nearer to the vacancy or the applicant. But out of this branch of the Employment Exchanges has come the contact with the regular officers of H.M. Forces and with younger men who are suitable for executive posts in industry. Again it is part of the service to deal with the other men and women and with ex-regular members of the Forces.

The story of the Ministry of Labour since 1916 is, in fact, part of the organic structure of the State, and nearly every factor of employment and the care of it is found in its pages. Fortunately, except for claims for unemployment benefit requiring a signature, all parts of it are voluntary. It did not happen at once. It grew up when factors demanded that it should grow up. The Second World War, when all the man-power resources had to be used, broadened the Ministry under the activities of Mr. Bevin. But Appendix II tells the story of the many different Ministers who fitted into each chapter of the story, and of other high permanent officials, among whom Sir James Masterson Smith curiously seems to have escaped mention.

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*The Brewing Industry 1886–1951.* By JOHN VAIZEY. Published for the Economic Research Council with a foreword by P. SARGANT FLORENCE. (London: Pitman, 1960. Pp. xix + 173. 30*s*.)

THIS book is to be welcomed because it is the first serious investigation by a professional economist of an industry whose own professional mystique has combined with political prejudice to discourage rational analysis. The author's perception and intelligence will ensure that his text will not be neglected. In essence, there are two inquiries in short compass: a brief history since 1886 (50 pages) and a more detailed examination of "the industry today" (110 pages). Such a juxtaposition of historical and contemporary investigation, linking analysis of the dynamics of change with that of structure and operation is completely justified, particularly for the brewing industry over which the past hangs so heavily. No economic historian can afford to neglect the conclusions revealed by the latter type of analysis, while the economist cannot be fully articulate in such an inquiry without awareness of the process of evolution which lies behind the present.

It is a pity that brevity limits the historical section to being in the main an orderly narrative of the sequence of trends in the industry, clearly related, without much room for the analytical investigation (from internal as well as printed sources) shown in the later chapters to be applied to the historical evidence. In fact, there is compensation for this in the considerable retrospective analysis contained in the second part of the book. From this later section the dominant reasons for the trends in historical evolution appear as conclusions. Many factors worked progressively in favour of the larger brewery and increased concentration in the industry: economies of scale in size of plant, the urge to employ plant to capacity, improving transport methods making mass distribution more economical over a widening area, rising fixed costs (particularly those of bottling plant) and aggressive national advertising after 1928. Other forces, more peculiar to the industry, provided great inertia against these trends: the economics of location determined siting almost completely at the market (except for the Burton brewers and Guinness); rail, lorry and recently bulk transport counteracted only by stages the inherent disadvantage of marketing a relatively cheap, bulky and delicate product over long distances; the markets were consolidated at an early stage in the industry's evolution by entrenched local brewers in control of retail outlets, enjoying the added defence of restricted licensing after 1869 and immobilised by all the non-economic motivations of family tradition. Although closely linked, there remain separate influences operating on the numbers of plants in operation and the numbers of firms possessing an independent existence.

The chapter on costs and efficiency in the industry show the author at his best. They are rigorous in analysis, subtle and penetrating in argument. Mr. Vaizey has obviously talked at length with brewers and studied the

figures they have provided to excellent purpose. Brewers should be fascinated by these comments no less than economists. Essentially, the methods used and the answers sought depend for success upon quantitative evidence being available in comparable form from several firms. Hence, it is no wonder that the attempt to submit the concept of profits to scrutiny does not yield as much precision. The complications arising from reticence about figures, differing accounting conventions and non-brewing income would need a Royal Commission to unravel. Even so, the tables drawn up from firms' records are amongst the most valuable evidence in the book. Events have been moving so rapidly in the brewing industry in the past decade that some parts of these investigations, which were completed in 1953, have dated a little, particularly those about the structure of the industry. The last detailed figures used are those of Leak and Maizels (based on the 1935 Census), where the industry proved to be " below average " in concentration. The count of subsidiaries and breweries up to 1951 has been overwhelmed by the stampede of firms into each other's arms since then, latterly encouraged by Mr. Clore wanting Watneys and the Canadian invasion. One or two other recent moves by some of the most influential firms also modify a little certain generalisations made here, such as Guinness spreading their capital and interests beyond the brewers' traditional fields of soft drinks, wines and spirits. It is a little odd to read in 1960 that " attempts to sell continental style lager have failed." Time and history impose their hazards on all judgment, however, and one can only regret the long delay in publication. In a book that sets out to judge and analyse one might beg leave to dispute some less contemporary assertions. Has modernity of equipment in fact proved " not especially important " (or does the truth of this in regard to vats and boilers break down when it comes to bottling plant and transport)? Did the return of better times to the industry in the 1930s first come with rearmament (production was moving up steadily after 1932 and expenditure on beer by the end of 1934)? Does the high degree of family control depend " primarily " on the tied house (for what of Guinness, the wine merchant and distilling dynasties and other examples)? Must the general decline in beer consumption between the wars be just a function of relatively higher beer prices, without benefit of changing social habits? More remotely the firm and family of Home were not among the major London firms in the eighteenth century. If Mr. Vaizey provokes arguments, that is a consequence of the main asset possessed by any book which provokes thought.

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*The Schuman Plan. A Study in Economic Cooperation, 1950–1959.* By WILLIAM DIEBOLD. (New York: Frederick A. Praeger for the Council on Foreign Relations, 1959. Pp. xviii + 750.)

MR. DIEBOLD is no newcomer to the study of European economic integration. His speciality are the early stages of integration that led to more. His first volume on the subject (*Trade and Payments in Western Europe*, reviewed in the June 1954 issue of this JOURNAL, pp. 367–8) dealt with the various European payments agreements which eventually led to the formation of the European Payments Union. The present volume deals with the "transitional period" of the European Coal and Steel Community from 1953 to 1958. In the event, this turned out to be not only a transitional period from economic nationalism in coal and steel towards a firmly entrenched E.C.S.C., but also a transitional period from integration by sectors towards the fairly comprehensive integration commenced by the European Economic Community.

Mr. Diebold starts at the beginning. He traces the "idea" to what everybody said about everything that seems relevant. Some of the *mots* he collected may help harassed examiners in search of questions, such as: "The difficulties of the realization of the Schuman Plan begin where the economic problems start." While all this is well told, one wonders whether greater economy of words in the first and last parts of the books would not have helped to convey the author's findings more effectively. For instance, tucked away amongst the 136 pages of Part One is one of the best summaries of the functions and powers of the High Authority extant in English literature on the subject (pp. 79–81). Similarly, the 150 pages of Part Four contain, on pp. 649–51, a clear and concise comparison of the powers and functions of E.C.S.C. and E.E.C. However, the book was not written for political scientists and economists alone, and these two groups of readers will find much meat in Parts Two and Three (pp. 139–564), which deal with the actual processes of integration by sector.

The history of E.C.S.C., as here recorded, shows the gradual ascendancy of the Council of Ministers over the High Authority. The High Authority's decisions just could not be implemented unless the national governments concerned at least accepted them. In practice, the High Authority had most authority when it negotiated with national governments and persuaded them of the desirability of a decision before such decision was actually taken. The High Authority has not really become a "supra-national" authority, but the hand-maiden of six governments with the will to co-operate within a specified sphere.

Such political limitation also limits the degree of economic integration which is practical in coal and steel. True, there is no more discrimination as far as infra-Community trade in coal and steel is concerned. At the same time, coal and steel cannot be treated in isolation. Governments could not

be, and were not, expected to adjust all laws and administrative practices just for the sake of perfecting integration in two trades. There was no co-ordination of transport policies, fiscal policies and policies relating to monopolistic practices. The consequence was that the conditions for intra-Community trade in coal and steel did not become altogether identical with the conditions for domestic trade in coal and steel—though the conditions for intra-Community trade became more like the conditions for domestic trade and less like the conditions for foreign trade.

Thus, Mr. Diebold shows how the abolition of discriminatory railway rates did away with differences in the treatment of national and Community coal and steel, but the rates applicable to the conveyance of coal and steel continued to be decided by each national railway system in the light of purely national considerations. Taxation continued to be determined by the needs of national budgets, so that countries with higher turnover taxes levied equalising charges. Before E.E.C., even external tariffs were only made more alike and did not become exactly equal, so that the degree of protection against third-party competition continued to vary (though less than before). National governments could no longer apply discriminatory price controls as far as coal and steel are concerned, but they could control prices of goods containing coal and steel. These, however, are minor blemishes, even from an idealised free trade point of view, compared with the difficulties in conferring freedom upon those who did not want it. In this sphere the High Authority could only provide some elementary education, but appears to have produced no graduates. Steel firms could be made to write down and publish their prices at various basing points, but nobody seemed surprised when all firms quoting at a particular basing point quoted the same prices. Coal owners who liked to sell through a marketing board could not be made to compete. The High Authority could do no more than to split the largest of these boards into three boards, in the hope that some competition might develop.

In all this, the High Authority had to tread warily in order to survive. It survived. On laying down Mr. Diebold's interesting volume, one has gained the impression that the High Authority, throughout the transitional period " did nothing in particular and did it very well."

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*Economic Development.* By Benjamin Higgins. (New York: W. W. Norton, 1959. Pp. 803 + xviii. 60*s.*)

This book adopts a pattern that has now become almost standard for a development text-book: an introductory discussion of the general nature of the development problem and the characteristics of underdeveloped countries, followed by chapters on various theories of development, some historical

lessons, explanations of the continued poverty of poor countries and finally policy proposals. In covering all this, Professor Higgins' book, like most others on development, is overly ambitious and inevitably superficial in parts, but it is superior to most texts in its strong and persistent emphasis on the analytical basis of the development process. While its foremost concern is the search for strategic functional relations, it never loses sight of the complexity and variability of development forces.

Not only are there the usual chapters on "general theories of development" from the classicists to post-Keynesians, but in addition various explanations of the current problems of underdeveloped countries are examined analytically by way of such "theories of underdevelopment" as geographic determinism, sociological dualism, technological dualism, colonialism and the "backwash effects" of international trade, and balanced growth and the "big push." The historical and policy discussions are also based on theoretical foundations.

Although this analytical emphasis is commendable, the content of the analysis is disappointing in several respects. An inordinately large part of the theoretical material consists simply of summaries from the existing literature—despite Professor Higgins' prefatory claim that this book reflects his own conclusions "rather than those of other writers in the field and is less of a digest of the literature than most textbooks." These condensations frequently take the form of long direct quotations, are presented with little explication or extension, and range rather indiscriminately from the esoteric to the most elementary. Many of the summaries will be meaningless to most undergraduates, and the original sources themselves would be more stimulating for advanced students.

Where the author's own conclusions do enter, they may be less than fully convincing to many readers. It is stated that "the major thesis of this book is the need to break out of the traditional mold of economic thought when we come to analyze the process of economic growth." To accomplish this Professor Higgins lists his own requirements of growth theory (pp. 766-7): we must "handle discontinuous functions"; "work with multisector models"; deal with "feedback mechanisms, not equilibrating adjustments"; "population growth, technological progress, and perhaps cultural change must be included as integral parts of the analytical system"; "analysis must be conducted in terms of group reactions rather than individual choice"; "every significant problem has to be handled in terms of a general system rather than by a partial equilibrium analysis"; and "the process must always be put into time and analyzed in terms of model sequence and linkages."

One may agree to all these requirements, but this book actually provides only a slight advance towards their realisation. The formidable list of *desiderata* is disposed of more by resort to metaphors and picturesque phrases than by conclusive argument. What Professor Higgins has done in a negative

vein, however, is to cast extreme doubt on traditional marginal analysis and equilibrium theory. In so doing, he places most emphasis (too much emphasis in this reviewer's opinion) on capital accumulation and capital–output ratios, technological dualism, entrepreneurial motivation and the "backwash effects" of international trade. From his own synthesis of theories of underdevelopment, Professor Higgins concludes that "there are only two ways of accelerating economic growth. One is to increase the level of per capita investment, the other is to reduce the incremental capital–output ratio" (p. 471). He also argues that "only a rapid change to extensive, mechanized agriculture, with enough industrialization to absorb the population displaced from the rural sector, will assure a take-off into steady growth" (p. 455).

In general, the policy discussion is rather narrow in its attack on "gradualism" as an approach to development policy, and in its alternative support of a "big push" through government intervention in the decision making process. Although the case for heavy development planning may be pertinent for some countries, its advocacy in this book falls short on two counts. On the analytical side the case has been biased by reducing almost all the required improvements to the requirement of capital formation. Other requirements are mentioned, but the emphasis on investment is so strong that a reader may be left with the impression that all that the poor country needs is capital expenditure and that the major, or even only, policy question is to find ways by which the capital expenditure can be financed. And on the applied side, the ability to plan and the capacity to administer a long-range development program are simply assumed to exist, with little pause over recent experiences that have revealed the premature character of planning and the resultant poverty of planning in many poor countries.

In short, students who rely on this text should also be made to realise how much relevance traditional analysis can have in illuminating development problems, and they should be aware of the counter-arguments against development planning. Provided this balance is achieved, this text may serve as a lively and competent survey of the economics of development.

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*An Economic Survey of Northern Ireland.* By K. S. ISLES and NORMAN CUTHBERT. (Belfast: H.M. Stationery Office, 1957. Pp. xxvi + 646. 35*s*.)

No economist who has visited Ulster could fail to be fascinated by the economic problems of this remoter part of the United Kingdom. Unfortunately, once back in Great Britian, it is very easy to forget Northern Ireland's special problems. Most official statistics lump Ulster in with the

rest of the United Kingdom and, as we page through the *Monthly Digest of Statistics*, the only significant fact about Northern Ireland which strikes us is the (inevitably high) unemployment percentage. This book deals with the economic problems of Northern Ireland and, in addition to the main text, there are seven appendices on such topics as saving and changes in the labour force. Perhaps the most interesting of these is Appendix G on cyclical variations in the linen industry, mainly during the inter-war years, by William Black.

The survey originated in a suggestion by Sir Roland Nugent that it might be helpful to make a study of the Ulster economy based on independent academic research. There is no attempt to make policy recommendations, nor to show why, with all Northern Ireland's disadvantages, real income and employment are as high as they are. One important result of the survey is that the authors have been forced to fill some serious gaps in Northern Ireland's economic statistics, for example, the absence of indices of wages, earnings, export prices and estimates of such aggregates as total personal incomes or investment. This task has been carried out with great diligence and efficiency, enabling the authors to make a detailed comparison of the economies of Great Britain and Northern Ireland.

Judged purely by its success in assembling the main facts about Ulster's economy, this is a first-rate piece of work. Though the authors did jib at the difficult task of calculating the invisible items in the balance of payments, they have made useful additions to statistical knowledge in their studies of civilian income and savings for Ulster. From these figures and from previously existing ones, the essentials of Ulster's economic problem are clear.

Income per head is low, even though the assertion (p. 16) that in 1949/50 44% of incomes in Ulster were below £50 per annum turns out to be merely a rather delightful misprint. The unemployment percentage as we know only too well is high, and the industrial structure very narrow. As much as 25% of the population is engaged in agriculture. In manufacturing industry, nearly half the men are in shipbuilding and engineering, including marine engineering; nearly half the women are in the linen industry. This concentration of employment in industries which have always been prone to depression and which now probably rank among Britain's declining industries, explains the unemployment problem of Northern Ireland and gives little hope for the future. Location policy has helped to move new firms to Ulster; indeed, it accounts for a very high percentage of extra employment created since the War. Even so, too few extra jobs have been created so far.

The basic reasons for Ulster's paucity of manufacturing industries lie in her lack of a large domestic market and the virtual absence of raw materials and of indigenous fuel—except peat. As a result, transport costs, especially for coal, are high, and indeed coal is subsidised for large industrial users.

The authors display great thoroughness in analysing and explaining these facts and considerable courage in their attacks on "monopoly" prices charged by Cross-Channel carriers and Belfast coal distributors, and in the virtual admission that large-scale migration to Great Britain must and will continue (p. 348). For the rest, they are forced to prescribe more subsidies or more public works and even to toy with such desperate remedies as a cut in real wages intended to increase employment in the export industries. However, they conclude that, when multiplier effects are allowed for, the net result even on employment might well be negative, particularly in view of their interesting conclusion that the income multiplier in Ulster is probably not greater than one and may be less.

One comes away from this book resigned to accepting Ulster for the foreseeable future as Britain's nearest poor relation and with the distinct impression that being debarred from making policy recommendations represented no real hardship to the authors of such a depressing study. Unfortunately, the authors' assiduity in collecting and analysing information is not matched by an ability to present it in a clear, concise and attractive way. The reader finishes the book feeling that what has been said could have been put infinitely better and more effectively in a book of about half the length. The authors cannot fairly be accused of being unable to see the wood for the trees; they do at various points pick out the key problems and set out possible solutions. Yet they manage to present the book so that these occasional attacks of clear-sightedness are swamped by a flood of verbosity.

One reason for this is an inability to prune. The book must surely contain every fact about Ulster that the authors have collected, whether important or merely mildly informative. Some of the ninety-odd statistical tables and the thirty-four charts in the text might have been relegated to the appendices or else scrapped altogether. The 429 closely-printed pages of the main text could have been cut to about half this length without the loss of any vital point of substance. For the whole is unforgivably prolix, and there is a great deal of repetition, some of it unnecessary and some caused by the inevitable need to remind the reader of what was said before, several thousand words back.

The student of Northern Ireland will find this book a mine of information. For anyone else, the task of struggling through it will probably prove too frustrating and exasperating. Fortunately, Chapters 17 and 18 contain the essence of the facts about Ulster and an analysis of their policy implications. They are also much better written—probably because the authors finally appear to abandon their unequal struggle to keep out jargon, presumably in a vain attempt to make the book attractive to the general reader. Anyone who does read these chapters will find the problems of Northern Ireland compelling and saddening. Ulster represents both a disappointment and a challenge; her problems, once understood, have immense intellectual fascination. It is unfortunate that Messrs. Isles and Cuthbert, despite all

their undoubted effort and persistence, should have failed so lamentably in presenting these problems in a stimulating and challenging way.

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*The Canadian Economy: Prospect and Retrospect.* By RICHARD E. CAVES and RICHARD H. HOLTON. (Cambridge: Harvard University Press (London: Oxford University Press), 1959. Pp. xxii + 676.)

HARD on the heels of the many-volumed Royal Commission on Canada's Economic Prospects (Gordon) Report, John Stovel's revision of the Viner literature on Canada's 1900–13 boom, and Firestone's giant statistical study of the four-score years since confederation, comes this independent view of almost two hundred years of development, ten of them still in the future. The second half of the present volume consists of a series of chapters based on reports to the Canadian Pacific Railway, who in 1955 retained a team of economists to estimate the location of economic activity and demand for railway transportation in 1970. The authors, leading members of that team, have condensed the numerical estimates, bolstered them with analytical and historical material, and prefaced the whole with Part I, a 250-page "Retrospect" of Canadian economic development. Indeed, if they had done nothing more than this threading together, on the strong strand of their analytical versatility, the anarchic Canadian historical and theoretical literature, they would have performed a great service.

In Chapter 2 they isolate three "strategic factors" in Canadian development: the role of staple exports; the absorption of population growth; and the meaning of "maturity" in a primary-producing economy. Of these, the staple theory of development (that newly settled countries are not transformed from self-sufficient agriculture to a balanced blend of primary, secondary and tertiary production, but specialise at once in exporting a "staple" which is replaced or augmented by later staples; and that the pattern of national development is explainable by the requirements and characteristics of the staple trade) forms the mortar for most of the volume. Its implications are ingeniously worked into a short-run theory of year-to-year fluctuations (Chapter 3) and two impressive statistical studies in Chapter 4. The first of these depends on a condensation and inversion of the forty-two-sector 1949 input–output table. The natural resource industries are left unaggregated, and tables are presented to show the strong sensitivity of the secondary industries to fluctuations in export demand for primary products and the weakness of the opposite linkage. The second is an econometric model for 1901–55, which applies Chapter 3's short-run relations established to long-run growth. While shortage of data frustrates this attempt, the attendant discussion does give proportion to the authors' view

of the determinants of both fluctuations and growth. (However, I would object that, contrary to Sutton, industrial productivity *increased* during most of the period 1945–50; see the Hood–Scott study for the Gordon Commission, Appendix 5 F. And I doubt the gain from an input–output study of compensatory fiscal policy based on the non-compensatory 1949 pattern of government capital expenditure.)

In Chapters 5 and 6 (after some hit-and-run history which must leave the foreigner still confused about the Hudson's Bay Company, colonial status and the various transcontinental railways), the authors consider systematically the changing structure and fortune of four main regions by isolating each region's manufacturing-employment multiplier for each primary staple. Tertiary-employment multipliers are also estimated. The successive booms in Alberta respond well to this treatment, as does agricultural central Canada. Some promising pages on the persistently slow growth of the Maritimes use foreign-trade multipliers on Ontario–Maritime trade, but end inconclusively. (Keirstead's analyses are not referred to; and on p. 168 surely the multiplier $E/(s + m) > 1$, if $m = 0$ and $s < 1$—in any case have not Regions A and B reversed their roles?) Indeed, the meaning of a staple employment multiplier is not made clear. If it includes makers of farm machinery should it not also include supplies to the petroleum and the Maritime logging industries? And should it include employment that would have grown without the staple, in Alberta oil processing or British Columbia's grain-trade? But these are caveats—the authors' use of the staple approach is very skilful and stimulating here, as in the succeeding Chapter 7 on government policy affecting development.

The 400-page " Prospect " in Part II (introduced earlier by Chapter 1, on methodology) rises logically from Part I. There is no space to mention the detailed procedures and assumptions, which are admirably explained throughout. Population and labour force are forecast, multiplied by expected productivity, and the resultant gross national product estimate divided among final-demand items, including exports. These in turn are multiplied by an inverted 1970 input–output table to obtain estimates of the output of each of sixteen industries, and imports—a most impressive undertaking. These then become the controls for six chapters forecasting (in regional detail) the main lines of development of each industry. Three comments may be suggestive of their content.

First the population prediction (from 1955) seems verified by preliminary 1960 data: growth by about 15% to almost 18 millions. Now the authors forecast it will grow to 21 millions in 1970, at only half the previous rate. They argue that by then the staple economy can absorb only 40,000 net immigration per year. This seems low, for recent figures show that even 1959 (with 9% unemployment) absorbed 58,000 net.

Second, the authors' discussion of their forecast of output per man year, which gives the impression that their 1970 gross national product will also

be on the bearish side, is slightly misleading. First, their rate of productivity increase is lower than that of the Gordon Commission, not because they are more pessimistic, but because they have stated it in *years* instead of man *hours* (neglecting the declining hours in the work-year). Second, they predict a drastic migration, by 1970, of 20% of the farm labour force into more productive occupations. Consequently their 1970 gross national product is a scant 4% less than the Gordon Commission's.

Third, government expenditure, investment, consumption, exports and many particular industrial items are forecast from trends fitted to past data. Where statistics are too skimpy, parameters are expertly transplanted from foreign (chiefly United States) studies. Procedures are clearly set forth, and difficult assumptions convincingly rationalised. I feel, however, that, as exemplified by the service- and forest-industries chapters, there was rather too resigned an acceptance of poor official series on employment or output. After all, census studies of distribution and provincial reports and micro-economic studies of forestry do exist. Even if these cannot be used to carry United States parameters forward, they are better than fitting trends to inconsistently defined national totals.

By reconciling in Chapter 20 their regional estimates, the authors provide three consistency checks on growth of production: geographically, by input–output and by expenditure. Although they recognise that consistency may only mean circularity, it is an astonishing achievement even to avoid being grossly inconsistent. But an astonishing achievement cannot by itself make Part II interesting except to specialists, even when a bright style is adopted. The retrospective Part I of the work, on the other hand, will be consulted for some years, for it is a first-class study of national and regional growth.

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*Dynamic Changes of Income and its Distribution in Japan.* By C. TAKAHASHI, in collaboration with R. IOCHI and K. EMI. (Tokyo: Kinokuniya Bookstore, 1959. Pp. 182.)

PROFESSOR TAKAHASHI and his collaborators have made a painstaking effort to collect and analyse all available data on income distribution in Japan. The information is based mainly on tax statistics. Modern forms of taxation were not introduced until the last years of the nineteenth century, following the break-up of the feudal system, and the scope of taxation became gradually wider. Data became abundant after the Second World War, when tax statistics were supplemented by family-budget surveys and welfare surveys.

The authors lean heavily on the application of Gibrat (log-normal) distributions which appear to fit the data, at any rate for the higher ranges

of income to which tax statistics relate; it is interesting that Gibrat himself commented upon pre-1914 Japanese data in his celebrated work.

The results of the analysis are difficult to interpret because of the gradual change in the nature and scope of the data. On the whole, the authors feel that there has been no long-term change in income distribution. Wars and calamities tended to cause increased inequality, which was then in subsequent years reduced. The post-war radical measures probably brought about increased equality but, as taxable income increased from 16% to over 50% of national income, the authors are not quite sure of this. Most of the analysis concerns the cyclical pattern of income distribution, and on balance evidence is adduced to support the view that in boom years inequality is higher, chiefly because profit incomes fluctuate more than wage incomes.

This is an authoritative work, and as such it is written for the specialist. In spite of the imperfections of data, it is possible to draw some conclusions, and it would have been useful had the authors done so more clearly.

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*The Economic Growth of Hong Kong.* By E. SZCZEPANIK. (London: Oxford University Press for the Royal Institute of International Affairs, 1958. Pp. xiv + 186. 25*s*.)

FEW regions have shown more rapid economic growth and structural change in the decade or so after the end of the Second World War than Hong Kong. Despite the decline of the Chinese entrepot trade, the scarcity of land and raw materials, the economic and social problems accompanying a population increasing rapidly through natural increase and refugee immigration, despite, above all, the uncertain political status of the area, Hong Kong has become one of the most industrialised and prosperous regions in Asia. It is Mr. Szczepanik's aim to provide both a descriptive outline of the economy, statistically illustrated, and an interpretation of the causal forces in the industrial revolution.

The picture that emerges is of an economy shocked into growth and change by certain powerful stimuli. The author sees the main stimuli in the pressure of population and the necessity to replace the lost entrepot trade by a new trade in exports indigenously manufactured. The leading sectors were building and textiles. About the latter we in Britain need little reminding. In 1956 textiles accounted for one-third of the working force in registered factories and 60% of the value of exports. The manifest inadequacy of Hong Kong housing, however, tends to make one forget the amount of building which has been undertaken. Between 1948 and 1956 no less than 5% of the national income went into building and construction. In the

wake of this boom followed ancillary industries such as cement, bricks, furniture, paint and electrical appliances. Hong Kong, like Japan, has also been quick to adopt new industries ranging from cameras to plastics.

Even allowing for the dubious accuracy of some of his figures, Mr. Szczepanik's evidence of economic expansion is convincing. The reasons for the remarkable response of production factors to the demand stimuli are more interesting. Apart from the provision of some essential social overhead capital, the government's role was passive. To private enterprise must go the chief credit for economic progress. The key to Hong Kong's achievements seems mainly to be found in three facts. First, the colony was fortunate in having an adequate supply of vigorous, innovating Chinese entrepreneurs, some of whom came from the mainland. Second, the labour supply was elastic, wages comparatively low and stable and the workers diligent and well trained. Third, much of the capital for development has apparently come from abroad, not in the form of aid from international bodies, but from non-government investors. On the sources and motives of this foreign investment the book, unfortunately, throws little light.

There are some criticisms one might make of Mr. Szczepanik's study. Covering as it does so wide a field in so short a space it is bound at times to be very superficial. The author has a penchant for Rostowian jargon which adds little to his argument, and he wrongly places the British industrial "take-off" in the mid-nineteenth century (p. 71). In the last section there is an attempt to apply sophisticated growth analysis to the Hong Kong situation, which suffers from the inadequacy of the data. I doubt, for example, whether the estimate of a capital–output ratio of 2 is meaningful or realistic in view of the extent of investment in building and social overhead capital. Despite limitations of this sort, the book is a valuable pioneering contribution on a neglected and worthwhile topic.

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*The Road to Self-Rule: A Study in Colonial Evolution.* By W. M. MACMILLAN. (London: Faber and Faber, 1959. Pp. 296. 35*s*.)

PROFESSOR MACMILLAN claims that his book fills a gap in that there has hitherto been no broad historical assessment of the British impact on what he calls the "less mature" peoples. The existence of the gap is beyond dispute. So far, most interpretative studies of British colonial policy towards dependent peoples have made generalisations from purely regional data. Furnivall, for example, built up his concept of the colonial plural society from an analysis of the effects of the western impact on South-East Asia. Yet Professor Macmillan falls into the same trap. He limits his grand review of British colonial policy and practice over the course of three centuries to

those particular countries he has lived in, visited or knows especially well. Most of his book is about South, East and Central Africa and the West Indies. Ghana and Nigeria get only very cursory treatment and the Asian dependencies have been omitted altogether. Professor Macmillan's reasons for disregarding Asia are idiosyncratic, to say the least. The claim that "British rule in India was never colonial" (p. 26) seems to be based on an original though bizarre concept of empire. This exclusion of Asia makes his ambitious survey extremely lop-sided, especially when he comes to discuss the British response to colonial nationalism.

Even as a work on Africa the book is rather a disappointment, coming as it does from so distinguished a pioneer of social studies in South Africa. The no-man's land between Hailey's giant survey and the microcosmic case studies being proliferated by the social scientists in the field badly needs to be put into focus for both the student and the general reader. Unfortunately, Professor Macmillan's survey is too personal and discursive in approach to make a good text-book and too much of a recital of well-established facts to interest informed students of African politics and economics. There is also much in the didactic and rather self-opinionated style of writing which may irritate those who have hitherto admired the vigour with which the author usually expresses himself.

The central argument of the book is that the colonial question is basically social and economic. On the tacit assumption that the British impact on "backward" peoples has been wholly beneficent by raising them to Western standards and values, Professor Macmillan argues that two right courses of action have always been open in the two main situations that have arisen. In societies with large white-settler groups the "less mature" peoples can throw off their backwardness by gradual absorption into the society of the settlers. This is what was intended by the Cape Liberals and the policy has failed only because of an insensate conflict within the white community itself. In countries without large settler groups only a very long colonial apprenticeship can lay a proper basis for the apparatus of modern states. This is what has happened in the West Indies, where Professor Macmillan thinks British colonial policy has achieved its most striking successes.

There is, of course, much truth in what Professor Macmillan says. Both British and African leaders have tended to view colonial rule too much in the purely political terms of the American revolution. There should be no false modesty about asserting that the under-developed countries best fitted to survive as reasonably well-run new states are precisely those which have experienced the longest period of political subjection to British colonial rule. And economic growth has undoubtedly been rapid in those territories with large settler groups. The difficulty is that Professor Macmillan is a rationalist who defends his position by shutting his eyes to the force of irrationalism. He refuses to accept the strident anti-colonialism and racialism of to-day and the final conviction of the colonial powers that modern empires do not

pay as significant factors in his rather simply formulated equation. It is surely too late in the day to remind those responsible for the future of East Africa that recent experience in other parts of Africa may suggest that good government is better than self-government. And as for Cape liberalism as the way out of the tragic imbroglio in the African plural societies, is it not being flatly rejected by Europeans and Africans alike? It is a pity that instead of lamenting that British colonial rule was not amended rather than ended Professor Macmillan did not give us a proper analysis of African nationalism. His treatment of it is decidedly sketchy. Little is said about urbanisation and the uprootedness of the *élites*. Nothing is said about regional economic disparities. And the analysis of indirect rule breaks no new ground.

There are also a few slips. It is not true to say that debt-slavery was "an almost peculiarly Spanish American phenomenon" (p. 13). It was widespread over much of South-East Asia. The grant of universal adult suffrage to Jamaica in 1944 was not an "unprecedented step" (p. 214). It was given to Ceylon as early as 1931. And can it be said that "the broodings" of Marx "took no account whatever of the colonial field" (p. 25) when there is so much evidence to suggest that he was engrossed by the impact of British rule on Indian society?

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# NOTES AND MEMORANDA

## SCHEDULE "A" INCOME TAX

An agitation for the abolition of Schedule "A" Income Tax on houses occupied by their owners has gained much strength recently. All Labour and Liberal M.P.s support it, and some Conservative Back-Benchers. Abolition is defended on the ground that it would encourage a "property-owning democracy" by inducing tenants to buy their homes. Would it have this effect, and is it in other ways justified? Let us see. As an illustration I assume three men Tom, Dick and Harry, each earning £1,500 a year, and living in houses rented at £100, purchase price £2,000, and tax £20 per annum. Tom has nothing apart from his salary, Dick gets a legacy of £2,000 from an aunt and buys his house, Harry has saved enough (having no family) to buy stocks yielding £100 a year. Why should not Dick pay the same tax as Harry? Each has £100 more than Tom.

Dick was fully aware of the £20 tax when he bought his home, and he paid so much less for it in consequence. Free of tax it would have been worth £20 multiplied by, say, fifteen years' purchase, or £2,300. Is there any reason why the House of Commons should make him a present of this £300, which other tax-payers will have to make up? Note at this point that abolition will not encourage tenants to buy, because they will have to pay the extra £300. If the Chancellor of the Exchequer announces on a Monday that he is abolishing Schedule "A" tax all saleable houses will at once be worth so much more to their *present* owners. Therefore abolition will mean an immense endowment of property at the tax-payer's expense, an odd proposal to come from Socialists. With some six million owner-occupiers it is, no doubt, a vote-catching proposal.

Most people, probably, think of Schedule "A" as a special tax on houses; it is in fact only the first of five schedules under which incomes are assessed. *Whitaker* explains that the assessment is made on the "annual value of Houses, Lands, Tenements, etc., including houses occupied by the owner." Allowances may be claimed for repairs, whether executed or not, as well as for insurance and agent's charges. Up to £40 the allowance is one-quarter, then it falls gradually to one-sixth. From recent statements in the Press it appears that many owners fail to claim these allowances; but this can hardly be made a reason for abolishing the tax.

All persons who draw an income from property of any kind have one general grievance—the high rate of Income Tax in time of peace. One hundred years ago the rate was 9*d.* in the pound; it sank to 2*d.* in 1875–77, and rose to 1*s.* 3*d.* during the Boer War. Even the Kaiser War did not send it above 6*s.*; why should it now be as high as 7*s.* 9*d.* in the £, the awkward

fraction of $\frac{11}{10}$ of a pound? No doubt there are two chief reasons: (1) the huge Government expenditure on Defence, Education and the "Welfare State"; (2) the large proportion of individual income which escapes assessment and taxation. "Differentiation," *i.e.*, a higher rate of tax on "investment income," was introduced because a Select Committee reported that it was "certain," while "earned income" was "precarious." This was in 1906, and the distinction had some meaning then. But the two World Wars and the depreciation of the pound sterling have altered the case entirely. Much property was destroyed by the two Wars, many old investments, *e.g.*, Consols, pay the same nominal interest or dividend in depreciated pounds and less seven times as much tax. Wages and salaries, on the other hand, have been raised constantly to balance the fall in the buying power of the pound.

One objection to Schedule "A" is that it is assessed on what the objectors call "notional income." Perhaps this argument might be carried much farther, so that other notional income may be brought under assessment. Tax is, as a rule, levied only on income received in cash, yet many workers get most, or a large part, of their remuneration by indirect payments. Thus secretaries, managers, schoolmasters, Fellows of Colleges, matrons, employees who "live in," and others, are paid "indirectly" by free board and lodging, free meals or rooms and so on.

For many persons the cost of board and lodging is the first and largest call on their income, and if they "live in" it may also be their main remuneration. But it escapes assessment; consequently, other tax-payers have to make up the revenue thus lost. Am I wrong in asserting that the most urgent change in our Income Tax law is the assessment of all forms of income?

J. E. ALLEN

*Cambridge.*

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## SIR ROY HARROD'S SECOND ESSAY

WHEN you believe you have successfully laid a ghost,[1] it is always a little disappointing, even after a lapse of ten years, to return to the empty house it once haunted and find it still rattling its bones. The bones to which I refer are described by Sir Roy Harrod as "an inexpugnable yardstick for cardinal measurement of the rate of decline in the utility of income as income rises"; [2] and the rattle is achieved by taking a worker, fixing a target output to be produced in a working day of given length and then varying both the

[1] J. de V. Graaff, "Mr. Harrod on Hump Saving," *Economica*, February 1950, pp. 81–90.

[2] R. F. Harrod, "Second Essay in Dynamic Theory," ECONOMIC JOURNAL, June 1960, para. 21.

basic rate of pay and the piece-rate in such a manner that the target output is just maintained.

It usually seems less pretentious to attempt the impugnment of inexpugnable things in small print. That is the course I shall adopt.[1] It will be seen that the bones rattle noisily only if the marginal disutility of work is assumed independent of income. In general, of course, this assumption is inadmissible. I leave the matter there.

The fundamental "supply" equation of the *Second Essay* depends for its interest on the possibility of guessing the size of the ghost, $e$, correctly defined in para. 14 as the elasticity, over the relevant range, of the schedule depicting the marginal utility of *consumption*, but incorrectly referred to almost everywhere else, and especially when it comes to rattling the bones, as the elasticity of the schedule depicting the marginal utility of *income*. The distinction, surely, is fundamental, and of particular relevance when what one really wants to know about is the behaviour of savings, defined as the *difference* between income and consumption. That, too, I leave there.

I turn instead to view the "supply" equation as a whole. It states that, in equilibrium, the natural rate of interest is equal to the natural rate of growth of income (it should actually be "consumption") *per caput*, divided by $e$. It is, of course, quite irrefutable. Not one of these quantities is observable. Not one occurs in nature. We have not one ghost, but three. Two have no bones to rattle. The third is condemned to rattle silently. What are we to make of it all?

What we should make of it is this. Dynamic economics will not itself experience the growth it professes to deal with unless its equations are set out, and its theorems stated, in terms that have some empirical content, so that they may, in principle at least, be tested against the facts they purport

[1] Let the basic rate be $q$ and the piece-rate be $p$, so that the worker's income, $y$, is $px + q$ when $x$ units are produced. The target output is fixed at $x = x_0$.

The worker maximises $U(x,y)$ subject to

$$px - y + q = 0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The first-order conditions are:

$$U_x + p\lambda = 0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

$$U_y - \lambda = 0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

where $\lambda$ is a Lagrange multiplier.

Now the elasticity of the schedule depicting the marginal utility of income is

$$-\frac{dy}{y} \cdot \frac{U_y}{U_{yy}}$$

so what we want is an expression for $U_y/U_{yy}$ in terms of observable quantities.

We proceed by differentiating (1), (2) and (3) totally and then setting $dx = 0$, as the target output is to be maintained at $x_0$. Solving, we readily obtain

$$-U_y/U_{yy} = (p + U_{xy}/U_{yy})(\partial y/\partial p)x_0$$

Experimental variation of $p$ and $q$ can tell us all about $\partial y/\partial p$, but nothing about the elasticity unless $U_{xy} = 0$—that is to say, unless the marginal disutility of work is independent of income.

to explain. Failing that, we might just as well squat down on our haunches, like real witch-doctors, and throw bones instead of rattling them. I wonder if our predictions would be noticeably worse.

J. DE V. GRAAFF

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## COMMENT

1. I HAD rashly supposed that it was intuitable that my analysis implied that the marginal disutility of work of variable intensity, *always supposing that the length of the working day (or of the working year) is rigidly fixed*, is independent of income; but I am glad to see this confirmed with the aid of a Lagrange multiplier. While many quantities in economics are mutually interdependent, some are taken to be exogenous. I would suppose that the marginal disutility of work, subject to the above proviso, is one of the latter. I therefore take the "of course" in Mr. Graaff's second paragraph as unwarrantable.

2. I fully admitted in my article that it is a defect in $e$ that it is not precisely measurable. I suggest that the limits within which its value is conjecturable are not too wide to defeat most practical policy proposals. This cannot be stated of all the values used in theoretical discussions. It is true that the natural rate of interest depends on the value of growth of consumption, not on that of income; but it was stated (p. 282, top) that in a dynamic equilibrium the rate of growth of consumption is equal to the rate of growth of income; and that was taken for granted in what followed.

3. In his penultimate paragraph Mr. Graaff refers to three quantities not observable. As two of these are *desiderata*, they are naturally not observable.

However, if policy makers are to influence the current rate of interest on the lines of my analysis, they must frame some *estimate* of the prospective natural rate of growth. They will, of course, be subject to margins of error here. Values that can be assessed only with margins of error of a certain size may be of far greater importance, both for economic theory and practice, than the values having smaller margins of error. All values have some margin of error, including the value data given in records of the past.

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# RESPONSE TO PRICE IN AN UNDER-DEVELOPED ECONOMY

MESSRS. BAUER AND YAMEY'S note [1] in the December 1959 issue of this JOURNAL, which used the changing composition of cocoa and palm-oil purchases in Nigeria during the lifetime of the national Marketing Boards as a counter illustration to the "well known and serious difficulties in measuring the degree of responsiveness of producers to price changes," is an over-simplification of the case. It is also unfair to the efforts of the many officials of the Ministry of Agriculture, Research Stations, Produce Inspection Service and other agencies of the Boards involved.

In the same issue of the JOURNAL Professor Lundberg [2] warned that "it is always dangerous to pick out and isolate one relation within a system of interdependent variables and draw conclusions of causal significance." Messrs. Bauer and Yamey have done just this, by taking the differential prices paid to producers for the various grades of the crops, and, apparently, assuming "the *ceteris paribus* of the theoretical formulations of functional relationships in economics." [3] The environment in which these price changes took place was not static. The increased output was not solely because the producer "knew the additional returns for improving his output by more careful tending of the trees, gathering of the produce and preparation for sale to the boards." [4] He had to be shown and convinced of this by propaganda in the form of pamphlets and posters; by demonstration plots and field experiments; by agricultural shows; by the subsidised spraying and cutting out of diseased trees (often against the farmer's wishes); by strict produce inspection standards and "measures to guard against adulteration, contamination, substitution, weight shortage, wrong grading and many other forms of chicanery"; [5] by intensive and skilled research (*e.g.*, £2·5 million was spent on the West African Oil Palm Research Institute up to 1954). Without the advance-payment arrangements "it is doubtful whether the Board's licensed buying agents (and in particular the Nigerian licensed buying agents) could have found the ready money to finance purchases" [6] at the high levels of producer prices paid.

They also seem to assume that the transport facilities remained unchanged. Large expenditures were incurred in each year in transport subsidies to bring the produce to the ports by uneconomic routes in order to

[1] P. T. Bauer and B. S. Yamey, "A Case Study of Response to Price in an Under-developed Country," ECONOMIC JOURNAL, December 1959.

[2] E. Lundberg, "The Profitability of Investment," ECONOMIC JOURNAL, December 1959.

[3] Bauer and Yamey, *op. cit.*, p. 800.

[4] *Ibid.*, p. 801.

[5] "Statement on the Activities of the Department of Marketing and Exports," Sessional Paper No. 6, 1953, Government Printer, Lagos.

[6] *Ibid.*, pp. 3–4.

avoid evacuation delays and the subsequent deterioration of quality or loss of the produce. The Boards themselves contributed large sums to the expansion and the improvement of the road system, which in turn made it

*Palm Oil Purchases by Nigeria Oil Palm Marketing Board 1949–54 and Producer Price Per Ton According to Grade Purchased.*

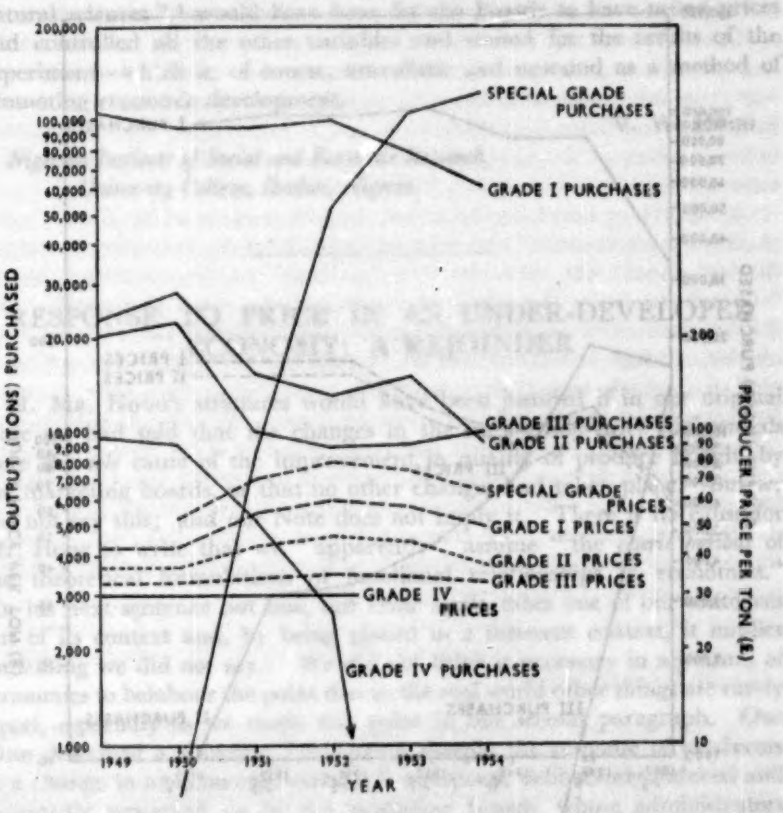


FIG. 1

possible for the producers "to respond." Special Grade palm oil, for example, only remains "special" if it is evacuated speedily and efficiently after being expressed by the subsidised hand presses and Pioneer Oil Mills. The increasing use of road transport as opposed to water or rail transport, together with the valuable work done by the United Africa Company's Bulk Oil plants at the ports is of importance and cannot be ignored.

Finally, their tables showing the percentage changes in the share of the different grades of produce take on a different look when they are displayed graphically. Figs. 1 and 2 below are more helpful in visualising "the

*Cocoa Purchases by Nigeria Cocoa Marketing Board 1947/8 to 1953/4 and Producer Price Per Ton According to Grade Purchased.*

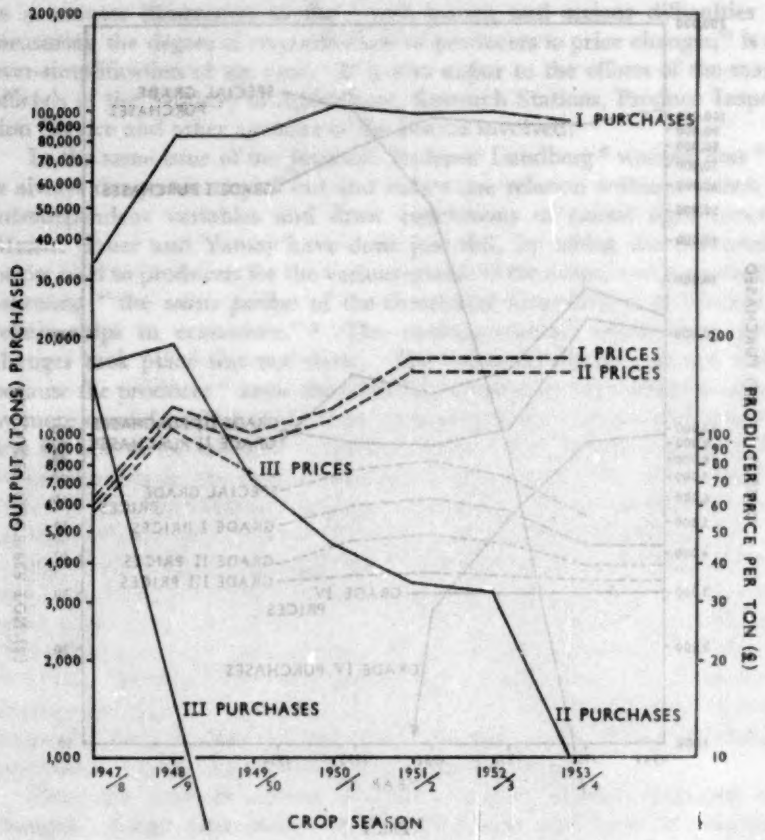


Fig. 2

degree of responsiveness" of output to the given price changes. It will be seen that the output increases are quite variable, and in some cases negative when looked at in absolute terms rather than in the changing percentage compositions within the total which they use.

The purpose of this note is not to deny the phenomena to which Messrs.

Bauer and Yamey draw attention, but rather to suggest that they should not allow their antipathy to these statutory export monopolies to over-emphasise the economic rationality of peasant producers. They should give at least some credit to the institutional changes in which the experiment took place and to the arduous efforts of the many officials involved in stimulating an interest in quality changes among the producers.

The true test of " the method of observation and experimentation in the natural sciences " [1] would have been for the Boards to have raised prices and controlled all the other variables and waited for the results of the experiment—which is, of course, unrealistic and unsound as a method of promoting economic development.

V. W. Hogg

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*University College, Ibadan, Nigeria.*

## RESPONSE TO PRICE IN AN UNDER-DEVELOPED ECONOMY: A REJOINDER

1. Mr. Hogg's strictures would have been justified if in our original Note we had said that the changes in the inter-grade price differentials were the *sole* cause of the improvement in quality of produce bought by the marketing boards, or that no other changes had taken place. But we did not say this; and our Note does not imply it. There is no cause for Mr. Hogg to write that we " apparently " assume " the *ceteris paribus* of the theoretical formulations of functional relationships in economics." (In his next sentence but one, our critic again takes one of our sentences out of its context and, by being placed in a different context, it implies something we did not say.) We did not think it necessary in a journal of economics to belabour the point that in the real world other things are rarely equal, especially as we made this point in our second paragraph. Our Note described a situation " exhibiting sharply the response of producers to a change in an economic variable," a response deliberately induced and repeatedly remarked on by the marketing boards, whose administrators were well placed to assess the relative effectiveness of the price inducement and of other influences. The boards made it quite clear that in their view the price differentials were the major factor, and often did not even mention other factors. Several extracts from their reports to this effect are in our Note. Further quotations from many similar passages in their reports would be otiose. Moreover, the responsiveness of the producers to price incentives is also illustrated unequivocally by other experiences

[1] Bauer and Yamey, *op. cit.*, p. 800.

reported by the boards, one of which was noted in our concluding paragraph.[1]

2. Our confidence in the soundness of the boards' assessment of the price inducement is somewhat strengthened by the fact that most of the other influences mentioned by Mr. Hogg have little or no bearing on the distribution of producers' efforts between production of different grades, which is the subject-matter of our Note. These irrelevant influences include: the control of tree disease; strict produce inspection; measures against malpractices; research; the financing arrangements of the boards; and improvement in port facilities. One or two of the other influences (*e.g.*, speedier transport making it possible to avoid deterioration in the best quality of palm oil) would have had a differential effect as between different grades. But this does not refute anything we—or the boards—have written.[2]

3. Mr. Hogg concludes by saying that the purpose of his Note " is not to deny the phenomena " to which we drew attention, but rather to suggest that we should not allow our " antagonism " to the marketing boards " to over-emphasise the economic rationality of peasant producers." But if it be meritorious to agree with the views expressed by these boards, then on this occasion at least we are on the side of the angels. For we agree with the boards that their inter-grade price differentials were a major factor in achieving the results desired by them. We have, it is true, elsewhere questioned the economic merits of the policy of the boards in raising the standard of their purchases by prescribing inter-grade price differentials far in excess of the differentials obtaining in the world market, and refusing to buy some produce which they could have re-sold. But our analysis of the merits of this policy is not relevant to the subject under discussion, which is the responsive of producers to price differentials.

P. T. Bauer
B. S. Yamey

*London School of Economics.*

[1] Yet another example is provided by the decision in 1953–54 of the Nigeria Cocoa Marketing Board to discontinue the payment of higher prices for " main crop " than for " light crop " cocoa. The differential had encouraged the mixing of " light crop " cocoa with the succeeding " main crop " cocoa, a practice which the Board did not like, and sought to discourage by removing that particular price differential.

[2] It should occasion no surprise—nor merit specific discussion—that marketing boards (and other government departments) which were anxious to raise the quality of output should not only introduce inter-grade price differences to provide incentives, but also do other things to facilitate the production of the more desired grades. (The first of our quotations from the boards' reports refers to the " necessary instruction " of the producers.)

# CURRENT TOPICS

THERE is an unsatisfied demand for copies of the ECONOMIC JOURNAL for March and June 1960. The Society will pay 5*s*. for any copies returned in good condition to the Secretary at the Marshall Library, Downing Street, Cambridge. No other issues than those mentioned above are required or will be purchased.

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THE Annual Conference of the International Economic Association was held at Konstanz in Germany during the first fortnight of September 1960. The subject of the conference was "The Economics of Take-off into Sustained Growth." Professor W. Rostow (Harvard, U.S.A.) was Chairman of the Programme Committee, and it was his theories that were principally under critical examination. The participants were drawn in the main from economic historians and statisticians concerned with the measurement of economic growth. Among those who contributed papers were Professor Rostow himself, Professor Gerschenkron and Professor North from the United States; Professor Habakkuk (who had collaborated with Miss Deane), Professor Cairncross and Mr. Berrill from the United Kingdom. The conference was able to draw substantially on the statistical studies of economic growth made in recent years in a number of countries under the general direction of Professor Kuznets. He himself was present and contributed one of a number of papers based on this material. It was no part of the objectives of the Conference to endorse or to reject Professor Rostow's theories. There can be no question, however, that the vigorous and hard-hitting discussion helped to clarify many of the issues that were under consideration. The papers and a brief summary of the discussion will be published during 1962 by Messrs. Macmillan (London).

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*Houblon-Norman Awards.* The Trustees of the Houblon-Norman Fund invite applications for Fellowships or Grants in aid of research into the working of industry and finance in Great Britain and elsewhere and the economic conditions affecting them. Fellowships, which are intended for experienced research workers, are awarded for full-time research for one year, which may be renewed for a second year. Grants are awarded for either full-time or part-time work. The amount of the awards, which will take effect from October 1, 1961, will depend upon the circumstances of the candidate and the probable expenses of his work. Applicants must be British subjects normally resident in the United Kingdom. The Trustees are prepared to relax this rule only in exceptional circumstances. Forms of application,

which may be obtained from the Secretary of the Fund, c/o the Bank of England, London, E.C.2, should be returned not later than March 1, 1961.

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*Economica*

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No. 4, 1960. *The Triumph of the Leninist Doctrine of Economic Planning. Reserves and Scope for Raising Labour Productivity in the Coal Industry:* K. KOLEV. *For the Reduction of Turnover Costs in State Wholesale Trade:* M. NAKOVA-RUSCHEVA. *Some Questions Concerning the Use of Loans for Minor Mechanisation:* I. DOCHEV. *Once More on the Project for a Varna–Devnya Ship Canal:* M. DEVEDZHIEV. *Scope for Reducing Fodder Costs per Unit of Production in the Farms of Agricultural Co-operatives:* G. SVINAROV.

No. 5, 1960. *A Decisive Stage in the Economic Competition between the U.S.S.R. and the U.S.A.:* S. SHARENKOV. *Complex Utilisation of Raw and Other Materials in Industry:* B. BENEV. *Some Problems in Defining the Economic Efficiency of Capital Investment in Factory Construction:* E. GEORGIEVA. *Problems of Vegetable Cultivation in Green-houses in Bulgaria:* K. KALCHEV. *The Development of the German Democratic Republic in the Period of the Seven-year Plan:* F. SLAVIK. *A Theoretical Conference on the Balances of the National Economy:* T. DINKOV.

No. 6, 1960. *The Economic Efficiency of the Utilisation of Chemical Fibres in the Textile Industry:* A. KEVORKYAN and M. TSOCHEV. *Determination of the Optimum Length of Rail and Road Haulage for a Planned Distribution of Freight:* N. DOINOV. *On Some Problems of Livestock Specialisation in the Danube District of Mikhailovgrad Region:* I. ZAKHARIEV. *The Construction of Irrigation Systems from Co-operative-farm Funds:* S. SUNGARSKI. *Prospects for Czechoslovak Industry in the Third Five-year Plan:* J. ČERNOHORSKÝ.

No. 7, 1960. *On Certain Problems Concerning the Improvement of the Fixing of Labour Norms in Our Industry:* D. SHOPOV and S. DOSEV. *Reserves for Increasing Labour Productivity in the Extraction and Enrichment of Metal Ores and in Metallurgy:* D. NANKOV. *Income from Individual Crops and Sectors in Co-operative Farms:* G. KOSTADINOV. *The Analysis of the Outlays from the Wage Fund in an Industrial Enterprise:* G. IORDANOV. *Socialist Reconstruction in the German Democratic Republic:* H. EMERICH. *How the 1960 Plan was Drawn Up:* E. TSVETANSKI.

*Finansy i Kredit* (*Bulgarian text*)

No. 4, 1960. *For a Higher Role for Financial and Bank Control. On the Questions of Changing Over to Long-term Credits for Financing State Fixed Productive Assets:* D. SAPUNDZHIEV. *The Raising of Labour Productivity and the Reduction of Production Costs in Industrial Production:* V. RANKOV. *Credits on Turnover in the Industrial Enterprises:* M. YANCHULEV. *On the Question of Defining the Economic Effect of Measures for Minor Mechanisation Financed from Loans:* D. KASABOV. *The Enterprise Should Have a Single Current Account at the National Bank:* I. POPOV. *The Position of the Pound Sterling:* A. STOICHEV. *A Scientific Conference on Problems of Soviet Finance:* M. RUSENOV.

No. 5, 1960. *On Some Questions of the Relative Development of Livestock Production and Increasing Its Productivity:* G. MOMESHKI. *The Significance of Finance in Accelerating Economic Development in Bulgaria:* G. SVRAKOV. *How to Raise the Efficiency of Capital Investment in Industry:* A. POPOV. *What the Territorial Plans of the Money Incomes and Outlays of the Population Show for 1960:* N. LAZAROV. *Some Questions of the Restraints on Excess Outlay in Estimates Prepared by Drafting Organisations:* M. MISOV.

No. 6, 1960. *To Raise the Role of Bank Control for the Economy:* A. YUGOW. *Ten Years of Service to the Finance and Credit System:* I. PALIISKI. *The Development of Pension Schemes in Our Country:* M. GESHKOV. *For a Relationship between the Wage Fund and the Fulfilment of the Production Plan by Type of Commodity:* K. MINCHEV. *Cost of Production in Municipal Enterprises and the Factors Affecting It:* S. KOVACHEV. *Additional Resources from the Internal Reserves of Enterprises in Financing Their Capital Investment:* F. FILEV. *Some Problems of the Theory of Amortisation:* L. KANTOR. *An International Meeting on Fundamental Questions of Insurance in Socialist Countries:* KH. P.

*Ekonomski Pregled* (*Serbo-Croat text, English summaries*)

No. 4, 1960. *National Wealth in the Territory of Belgrade:* I. VINSKI. *Some Aspects of the Problem of Demographic Investment:* D. VOJNIĆ. *Basic Elements and Principles of Commercial Policy in Industrial Enterprises:* J. GOJANOVIČ.

No. 5, 1960. *The Conditions of Economic Equilibrium and a Concrete Reproduction Scheme:* I. FRIŠČIĆ. *Problems of Inventory Policy in Industrial Enterprises:* J. GOJANOVIĆ. *Trends of Bread Consumption in Yugoslavia in the Twentieth Century:* J. ŠTAHAN. *Financing State Enterprises in Capitalist Countries with Special Reference to France:* Z. FEDOROWICZ.

*Ekonomist* (*Serbo-Croat text, some French or English summaries*)

No. 2, 1960. *General Problems of Correlation Between Urbanisation and Economic Growth:* P. Ivković-Ivandekić. *Some Problems of the Economic Co-ordination of Inland Transport:* M. Aleksić. *A Model with an Average Capital Coefficient:* D. Stojanović. *On the Methodological Problem of Planning Scientific and Technical Personnel:* B. Šefer. *On a Soviet Model of Economic Growth:* B. Horvat. *The Utilisation of the Agricultural Area of Yugoslavia:* N. Dragićević.

*Közgazasági Szemle* (*Hungarian text, English and Russian summaries*)

No. 6, 1960. *The Planned Utilisation of Man-power—Planning the Requirements and the Supply of Skilled Workers:* J. Timár. *Calculations on the Efficiency of Technical Development and Investment:* J. Kornai. *Property Relations and Commodity Production:* L. Nemes. *The Production and Distribution of Vegetables and Fruit:* I. Kádár. *The Operation of the European Steel and Coal Community:* F. Kozma. *A Discussion on Present-day Capitalism:* T. Dimitriosz. *Amortisation in Producers' Co-operatives of the German Democratic Republic.*

No. 7, 1960. *The Structure of Industrial Production and Labour Requirements:* J. Wilcsek. *The Main Element in the Solution of Our Power Problems Is to Increase the Use of Oil and Gas:* V. Mihaletzky. *The Role of Amortisation in the Expansion of Fixed Assets:* T. Dániel. *The Optimisation of Foreign Trade Relations:* Gy. Symon and Gy. Kondor. *The Seasonal Nature of Retail Trade in Rural Co-operatives:* E. Kemenes. *The Evolution of the British Balance of Foreign Lending Since the Second World War:* K. Kövér. *The Development of the Qualitative Indices of the Power Bases of the Soviet Union:* j. Bors. *The Agriculture of the Popular Democracies:* K. Boskó. *The Economic Significance of the Producer–Co-operatives' Own Mechanisation:* C. Csizmadia. *The Path of the British Middle Class:* A. Bródy.

*Statisztikai Szemle* (*Hungarian text, English and Russian summaries published quarterly*)

June 1960. *Problems of the Application of Sampling Methods in the Field of Index-number Computation:* L. Drechsler and P. Kövés. *Some Questions of Electrification:* L. Orosz. *The Examination of Hungarian Foreign-trade Relations on the Basis of the Input–Output Table:* F. Nyitrai. *The Statistical Estimation of Fruit Yields:* G. Párniczky and P. Tomcsányi. *A Debate on the Dissertation of A. Román. A Morbidity Survey Covering 700 Worker and Employee Families in Budapest:* E. Heinz and I. Vályi. *The 1959 Results of Motels at Lake Balaton:* L. Langer and P. Soós.

July 1960. *The Economic Efficiency of Capital Investment and Its Statistical Analysis:* N. Shchadilov. *The Role of Imported Consumer Goods in the Supply of the Population:* I. Fenyö. *The Selection of Indicators Used for International Comparisons of the Standard of Living:* L. Czeh-Szombathy. *The Statistical Examination of Fixed Assets in the Engineering Industry—I:* M. Ságl. *Urban Migratory Movements with Special Reference to the Principal Cities:* E. Pallós. *Loading Operations in Transport by Lorry:* L. Csentes. *An International Comparison of Systems of National Accounts:* Z. Kenessey. *The Report of the Berlin Conference on the Compilation of a Uniform Product Nomenclature:* F. Nyitrai.

*Probleme Economice* (*Rumanian text, English, French and Russian summaries*)

No. 5, 1960. *The Draft Directives of the Third Congress of the Rumanian Workers' Party on the Economic Plan for 1960–65 and the Long-term Economic Programme. On the Nature and Content of the Cost of Production under Socialism:* Gh. Cretoiu. *The Development of Short-term Credit in Our Country:* Gh. Popovici. *The Reactionary Character of the Conceptions of V. Madgearu on Rumanian Economic Development:* S. Dumitrescu. *The Working Class of Western Europe Struggling Against "Integration":* I. Anghel. *The Development of the Czechslovak National Economy:* J. Vlcek. *Rising Living Standards in Czechoslovakia:* O. Šik. *Aspects of Trade Relations Between Socialist and Capitalist Countries:* E. Bibiri.

No. 6, 1960. *Current Problems in Increasing Labour Productivity and the Rational Utilisation of Man-power:* I. Bati. *The Importance of the Utilisation of Productive Capacity in Industry:* A. Iancu. *Increasing Profits Is an Important Task of State Farms:* B. Schiopu and E. Jianu. *Socialist Accumulation—The Basis of Production Expansion and the Increase in Popular Welfare:* I. Tulpan. *On the Amortisation of Fixed Assets:* I. Iţicovici. *Some Aspects of the Exploitation of the Working Peasantry in Bourgeois-landlord Rumania:* O. Popescu, N. Toma and N. David. *The Anti-working-class Aspect of Contemporary Bourgeois Theories on Inflation:* B. Comisioner. *Economic Results of the Utilisation of Maize for Silage in Some State Farms:* Gh. Ioniţa and E. Popescu.

# NEW BOOKS

## *British*

ABRAMS (M.) and ROSE (R.). Must Labour Lose? A Penguin Special, with a commentary by R. HINDEN. Harmondsworth, Middlesex: Penguin Books, 1960. 7." Pp. 127. 2*s*. 6*d*.

[This reprints the well-known articles by Dr. Mark Abrams on voters' attitudes, which originally appeared in *Socialist Commentary*. Dr. Abrams' report on the survey is followed by essays by Richard Rose, of Nuffield College, Oxford, and by Rita Hinden, the editor of *Socialist Commentary*. Dr. Rose considers the findings of the survey in a broader context of studies of how people vote and how the party system works, and Dr. Hinden discusses the implications for the Labour Party.]

AUBURN (H. W.) (Ed.). Comparative Banking in Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, U.S.A., U.S.S.R. London: Waterlow, 1960. 9". Pp. x + 118. 17*s*. 6*d*.

[This brings together in book form a series of articles which appeared in *The Banker's Magazine*. These articles provide a brief description of the banking systems of each of the chief countries of Europe and the United States. The contributing authors are in all cases practical bankers.]

BENHAM (F.). Economics. 6th edition. London: Pitman, 1960. 9". Pp. xvi + 575. 20*s*.

[The substantially revised new edition of Professor Benham's text-book was reviewed in the ECONOMIC JOURNAL of March 1956 by E. A. G. Robinson. The present re-issue embodies only minor revisions, mainly to bring the facts and figures up to date.]

BLACK (R. D. C.). Economic Thought and the Irish Question, 1817–1870. London: Cambridge University Press, 1960. 9½". Pp. xiv + 299. 37*s*. 6*d*.

[To be reviewed.]

BLYTH (C. A.). The Use of Economic Statistics. The Minerva Series, No. 5. London: Allen & Unwin, 1960. 9". Pp. 249. 28*s*.

[To be reviewed.]

BODELSEN (C. A.). Studies in Mid-Victorian Imperialism. London: Heinemann, 1960. 8½". Pp. 226. 25*s*.

[This is a photographic reprint of a historical classic which first appeared in 1924.]

Britain's Coal. Report of a Study Conference organised by the National Union of Mineworkers. London: National Union of Mineworkers (222 Euston Road, N.W.1), 1960. 9½". Pp. 90.

[This pamphlet prints three papers presented to the sessions of a short conference organised by the National Union of Mineworkers and attended by some forty experts drawn principally from the fuel and power industries, from politics, from economics and from industrial journalism. The first paper, by Mr. E. F. Schumacher, entitled " Coal—the Next Fifty Years," deals principally with the longer-term problems of energy supply, the importance of coal as the largest national reserve of energy, the difficulties of attaching meaning to such words as " economic " and " uneconomic " as applied to non-renewable resources which must be conserved and used at some time, sooner or later. He argues the case for great caution in abandoning usable coal or even in applying a " best-seams-first " policy. Not all of his audience would appear to have been ready to go all the way with him in this respect. The second paper, by Mr. S. Kessler, Research Officer of the National Union of Mineworkers, is on " Coal—the Present Situation." The author describes recent policies and argues strongly the case for a clear national fuel policy and for " fair " pricing; he is concerned, in particular, at the low price of fuel oil imported into this country. The last paper, by Dr. T. A. Townsend, is on " Coal and Science " and describes in terms intelligible to a layman some of the research that has been proceeding into the constitution of coal and into the problems of gasification and of methods of improving steam-raising.]

CAMPBELL (R. W.). Soviet Economic Power. Its organization, growth and challenge. London: Stevens, 1960. 8½". Pp. xii + 209. 30*s*.

[To be reviewed.]

CROFT (M.). Apprenticeship and the "Bulge." Fabian Research Series, No. 216. London: The Fabian Society (11 Dartmouth Street, S.W.1), 1960. 8¼". Pp. 20. 2*s*. 6*d*.

[The author describes from her experience as a Youth Employment Officer the present situation regarding apprenticeship, in which only a small proportion of boys who would like to be taken on as apprentices are successful in finding a place, notwithstanding that there is a shortage of skilled labour in many industries. She considers the reasons for this situation and the various proposals that have been made to deal with it before it is aggravated by the bulge. She ends by suggesting a number of different measures, all of which she considers to be feasible in present circumstances, even if they are not necessarily what would be regarded as ideal if one were starting from a clean sheet.]

DUESENBERRY (J. S.) and PRESTON (L. E.). Cases and Problems in Economics. London: Allen & Unwin (New York: Prentice-Hall), 1960. 9". Pp. xv + 195. 15*s*.

[To be reviewed.]

Economics. National Book League Reader's Guide. London: Cambridge University Press for the National Book League, 1960. 8¼". Pp. 30. 3*s*. 6*d*.

[This is a list of books on economics suitable for recommending to non-economists. They are classified under subjects, and brief notes are given on each book. The list is quite a long one, comprising well over a hundred titles, but the arrangement is such that the reader can pick and choose, and some indication is given of the level of difficulty by the order in which the books are listed in each section.]

EDEY (H. C.). Business Budgets and Accounts. London: Hutchinson, 1960. 7½". Pp. 174. 12*s*. 6*d*.

[To be reviewed.]

EINZIG (P.). In the Centre of Things. London: Hutchinson, 1960. 8¼". Pp. 319. 30*s*.

[To be reviewed.]

ELKAN (W.). Migrants and Proletarians. Urban labour in the economic development of Uganda. London: Oxford University Press for the East African Institute of Social Research, 1960. 9". Pp. 149. 21*s*.

[To be reviewed.]

FAY (C. R.). The World of Adam Smith. Cambridge: Heffer, 1960. 9". Pp. vii + 97. 15*s*.

[To be reviewed.]

FERNS (H. S.). Britain and Argentina in the Nineteenth Century. London: Oxford University Press, 1960. 9". Pp. 517. 63*s*.

[To be reviewed.]

GRANICK (D.). The Red Executive. A study of the organization man in Russian industry. London: Macmillan, 1960. 8". Pp. 334. 21*s*.

[To be reviewed.]

GUERNAULT (P. H.) and JACKSON (J. M.). The Control of Monopoly in the United Kingdom. London: Longmans, 1960. 9". Pp. ix + 197. 25*s*.

[To be reviewed.]

HADFIELD (C.). The Canals of South Wales and the Border. Cardiff: University of Wales Press; London: Phoenix House, 1960. 8¼". Pp. 272. 30*s*.

[The author is an enthusiast on canal history, and he has already written several books on the subject. He here provides detailed histories of each of the main canals of the region, from the time of their construction up to the present day, based on painstaking and extensive researches in British Transport Commission Historical Records and elsewhere. The narrative is by no means confined to the geographical development of the canals, and much interesting material is included on their finances and on the traffic they carried. Mr. Hadfield in his preface himself very fairly describes the character of the book and what it achieves when he writes: "I do not conceive myself to be writing economic history, but describing for the ordinary reader interested in canals or in the locality how the canals came to be built where we find them. There is here . . . material for the economic historian, but it is for him to describe how canal development fits into the pattern of general economic growth."]

HANNAN (E. J.). Time Series Analysis. A Methuen Monograph on applied Probability and Statistics. London: Methuen, 1960. 7½". Pp. viii + 152. 21*s*.

[To be reviewed.]

HUGHES (J.). Nationalised Industries in the Mixed Economy. Fabian Tract 328. London: The Fabian Society (11 Dartmouth Street, S.W.1), 1960. 8½". Pp. 40. 4*s*.

[The general burden of this vigorous essay is that, as things are at present, nationalised industries are constrained to follow policies that are to their own disadvantage in order to make life easier for the private sector. Particular aspects of policy which are criticised include the principle of break-even pricing, the absence of competition in awarding contracts to private firms, the obstacles in the way of nationalised industries developing profitable new lines of production and the excessive use of the public sector as a stabiliser.]

HUNT (K. E.) and CLARK (K. R.). The State of British Agriculture, 1959–60. Oxford: Oxford University Agricultural Economics Research Institute, 1960. 8½". Pp. 150. 15*s*.

[This is a most convenient and useful collection of statistics relating to British agriculture and its place in the economy. It is one of an annual series. In addition to the data for the current year and other recent years, charts are included showing the movement of the more important magnitudes over long periods. Certain changes have been made from previous years' editions: the brief commentaries which previously accompanied the statistical data have been dropped, and the foolscap format has been replaced by a much handier one.]

HUTTON (G.). Inflation and Society. London: Allen & Unwin, 1960. 9". Pp. 161. 15*s*.

[Mr. Hutton has written a hard-hitting popular pamphlet against the iniquities of inflation. The remedies, as he sees them, are two: " to cut down the pressure of new money and credit, by cutting Government and State expenditure to fit reasonable tax revenues (such as give people of *all* classes and incomes incentives) and to fit the available savings which the State and private enterprise can borrow at free market rates of interest, at medium or long term "; and secondly " to raise productive efficiency (productivity) in all walks of economic life by cutting down restrictive practices of all kinds, by improving managerial techniques . . . and machines and then letting them turn out all they are capable of producing."]

KALDOR (N.). Essays on Value and Distribution; Pp. 238; 35*s*. Essays on Economic Stability and Growth; Pp. 302; 42*s*. London: Duckworth, 1960. 9".

[To be reviewed.]

KAYE (B.). Upper Nankin Street, Singapore. A sociological study of Chinese households living in a densely populated area. Singapore: University of Malaya Press (London: Oxford University Press), 1960. 9". Pp. xvi + 439. 50*s*.

[The main purpose of this sociological survey of an exceptionally overcrowded (22 square feet of space per equivalent adult on average) street in Singapore is to assess the degree of " neighbourliness " among the inhabitants and the factors affecting it. The survey methods adopted and the resulting data are given in extreme detail, partly to assist in designing future inquiries. The result is a rather indigestible volume, and the results are not made to stand out in the clear way that would have been most useful to economists. However, much of the material is of interest, and the preparatory surveys which are described give a great deal of information on general living conditions.]

Land Ownership and Resources. A course of lectures given at Cambridge in June 1958. Cambridge: Department of Estate Management, University of Cambridge, 1960. 9". Pp. 136. 15*s*.

[This contains a group of lectures given in Cambridge in 1958. The speakers and their subjects were: Sir Solly Zuckerman on Natural Resources and the National Estate; J. Enoch Powell on Development Policy and the National Estate; Lord Parker on the Report of the Franks Committee and the Rights of the Individual; C. H. J. Maliepaard on Development of Land in the Netherlands; P. A. Stone on Building Economics; and D. R. Denman on The Estate in Land and the Employment of Resources.]

LEYS (C.) and PRATT (C.) (Eds.). A New Deal in Central Africa. London: Heinemann, 1960. 9". Pp. xiv + 226. 21*s*.

[To be reviewed.]

LINKE (L.). Ecuador. Country of contrasts. 3rd. edition. London: Oxford University Press for the Royal Institute of International Affairs, 1960. 8″. Pp. ix + 193. 25*s*.

[This is a revised edition of a book which first appeared in 1954. It provides a mainly descriptive but interesting account of the country's history, politics, social structure and economy.]

MACDONALD (D. F.). The State and the Trade Unions. London: Macmillan, 1960. 9″. Pp. vii + 199. 21*s*.

[To be reviewed.]

MCINNIS (E.), HISCOCKS (R.) and SPENCER (R.). The Shaping of Postwar Germany. London: Dent, 1960. 9″. Pp. 195. 21*s*.

[The first 150 pages provide a factual survey of the development of the German problem in East–West relations since the war. In a concluding chapter Mr. MacInnis discusses the problem more analytically and considers future prospects.]

MEYER (F. V.). The Seven. A provisional appraisal of the European Free Trade Association. London: Barrie & Rockliff with the Pall Mall Press, 1960. 9″. Pp. viii + 140. 18*s*.

[To be reviewed.]

MYRDAL (G.). Beyond the Welfare State. Economic planning in the welfare states and its international implications. London: Duckworth, 1960. 9″. Pp. xiv + 214. 21*s*.

[To be reviewed.]

NEALE (A. D.). The Antitrust Laws of the U.S.A. A study of competition enforced by law. London: Cambridge University Press for the National Institute of Economic and Social Research, 1960. 9½″. Pp. xvi + 516. 45*s*.

[To be reviewed.]

NORTCLIFFE (E. B.). Common Market Fiscal Systems. London: Sweet & Maxwell, 1960. 10″. Pp. 90. 21*s*.

[This contains a description of the taxation systems of Italy, Belgium, Holland, France and Western Germany. It has been prepared partly for the guidance of business-men trading with those countries, and partly as a background to discussion about harmonisation of tax systems within the Common Market. The author's lucid treatment is not limited to mere description of the law, and includes also brief discussions of the merits in theory and practice of the various systems described. It is therefore of interest to the student of taxation in general. The contents previously appeared as a series of articles in the *British Tax Review*.]

Oxford Regional Economic Atlas. The Middle East and North Africa. Prepared by the Economist Intelligence Unit and the Cartographic Department of the Oxford University Press. London: Oxford University Press, 1960. 10½″. Pp. 135. 42*s*.

[This is the second regional atlas to appear in this series, the first having dealt with the U.S.S.R. and Eastern Europe. It is divided about equally into maps and text (notes, statistics and gazetteer). The maps include fairly large-scale general maps of the more important parts of the region, and topic maps of the whole region, dealing with oil, agriculture, irrigation, communications, etc. The text brings together useful summary statistical indicators of the economic conditions of the various countries in the region and also particulars about development schemes.]

PARES (R.). Merchants and Planters. Economic History Review Supplements, No. 4. London: Cambridge University Press for the Economic History Society, 1960. 10″. Pp. 91. 10*s*. 6*d*.

[To be reviewed.]

PARKINSON (J. R.). The Economics of Ship-building in the United Kingdom. University of Glasgow Social and Economic Studies VI. London: Cambridge University Press, 1960. 9½″. Pp. xii + 227. 40*s*.

[To be reviewed.]

RICH (E. E.). Hudson's Bay Company, 1670–1870. Volume II: 1763–1870. London: The Hudson's Bay Record Society, 1959. 9½". Pp. 975.

[To be reviewed.]

RICHARDSON (J. H.). Economic and Financial Aspects of Social Security. An international survey. London: Allen & Unwin, 1960. 9". Pp. 270. 30*s*.

[To be reviewed.]

ROBERTSON (D. J.). Factory Wage Structures and National Agreements. University of Glasgow Social and Economic Studies V. London: Cambridge University Press, 1960. 9¼". Pp. xii + 260. 40*s*.

[To be reviewed.]

ROBINSON (JOAN). Collected Economic Papers, Vol. II. Oxford: Blackwell, 1960. 9". Pp. viii + 281. 30*s*.

[To be reviewed.]

ROBSON (W. A.). Nationalized Industry and Public Ownership. London: Allen & Unwin, 1960. 9½". Pp. 544. 50*s*.

[To be reviewed.]

ROSE (H. B.). The Economic Background to Investment. London: Cambridge University Press for the Institute of Actuaries and the Faculty of Actuaries, 1960. 9". Pp. xi + 661. 40*s*.

[To be reviewed.]

RUBNER (A.). The Economy of Israel. A critical account of the first ten years. London: Cass, 1960. 8½". Pp. xxiii + 307. 25*s*.

[To be reviewed.]

The Soviet Seven Year Plan. A survey of economic progress and potential in the U.S.S.R. London: Phoenix House, 1960. 7½". Pp. 126. 10*s*. 6*d*.

[To be reviewed.]

STAMP (L. DUDLEY). Applied Geography. Hardmondsworth, Middlesex: Penguin Books, 1960. 7". Pp. 208. 3*s*. 6*d*.

[This little book attempts to demonstrate, in simple, non-technical language, what geographers have done towards the interpretation and solution of such practical problems as land-use planning and industrial location. It does so mainly by setting out a series of examples, liberally illustrated with the maps which Professor Stamp regards as the special tool of the geographer.]

Study of the Japanese Wool Textile Industry. London: The Economist Intelligence Unit (22 Ryder Street, S.W.1), 1960. 11". Pp. vi + 40.

[The purpose of this study is to consider possible implications of developments in the Japanese woollen industry for British exports and for British imports from Japan. It contains two main parts: a descriptive analysis of the industry and an analysis of Japan's trade policy in respect of wool and wool textiles. A brief third part assesses likely future trends of Japanese wool textile exports. Large surplus capacity in the industry and widespread discrimination against it by foreign countries are among the most important features of the present situation.]

TEW (B.). International Monetary Co-operation, 1945–60. Fifth Revised Edition. London: Hutchinson, 1960. 7½". Pp. 192. 12*s*. 6*d*.

[The first edition of Professor Tew's admirable and widely used text-book was reviewed in the ECONOMIC JOURNAL of September 1953 by P. D. Henderson. Since then several revised editions have appeared, and this is the latest. New material has been added to bring it up to date, and the concluding chapter is now significantly entitled "Back to the Gold Standard." The author here points out the unsatisfactory features of present international monetary arrangements and discusses the so-called Triffin plan as a possible way out. Although the new material incorporated on recent events adds considerably to the usefulness of the book, some readers may feel that the author has not yet submitted it to the large-scale rewriting that would be needed to shift the emphasis decisively away from the 1940s towards the 1950s and 1960s. Thus few readers of the sort for whom the book is mainly intended are now likely to be very interested in the details given about the Intra-European Payments Agreements. Perhaps Professor Tew will feel moved to undertake a more thorough-going revision next time a new edition is called for.]

VAJDA (S.). An Introduction to Linear Programming and the Theory of Games. London: Methuen (New York: John Wiley), 1960. 9″. Pp. 76. 9*s.* 6*d.*

[Linear programming and the theory of games are here dealt with in two separate essays. Both are very clearly written, but the one on game theory is the better suited to the needs of the economist who wants to know what it is all about. The essay on linear programming is essentially an elementary account of how to set about solving a linear programming problem, and though the author clearly explains what a linear programming problem is, he does not try to relate it to the concepts with which traditionally educated economists are more familiar.]

WHETHAM (EDITH). The Economic Background to Agricultural Policy. London: Cambridge University Press, 1960. 9″. Pp. xii + 147. 22*s.* 6*d.* (paper edition 13*s.* 6*d.*).

[To be reviewed.]

## *Canadian*

IRVING (J. A.). The Social Credit Movement in Alberta. Toronto: University of Toronto Press, 1959 (London: Oxford University Press, 1960). 9¼″. Pp. xii + 369. 48*s.*

[This is a narrative and analysis in social and political terms of the process by which the Social Credit movement came to power in Alberta. The author sets out to assess the relative importance in promoting the success of the movement of social and economic conditions, of the philosophy of Social Credit itself, and of the personality and tactics of its leader Aberhart.]

## *Indian*

BERNA (J. J.). Industrial Enterpreneurship in Madras State. Bombay and London: Asia Publishing House for the International Industrial Development Center, Stanford Research Institute, 1960. 9″. Pp. xvi + 239. 45*s.*

[To be reviewed.]

RAJ (K. N.). Some Economic Aspects of the Bhakra Nangal Project. A preliminary analysis in terms of selected investment criteria. Bombay and London: Asia Publishing House, 1960. 9″. Pp. xii + 140. 28*s.*

[To be reviewed.]

## *Pakistani*

FEI (J. C. H.) and RANIS (G.). A Study of Planning Methodology with Special Reference to Pakistan's Second Five-year Plan. Monographs in the Economics of Development, No. 1. Karachi: Institute of Development Economics (Old Sind Assembly Building, Bunder Road, Karachi), 1960. 8½″. Pp. 27.

[This is a taxonomic survey of the problem of deciding what should be treated as a variable and what as a given in drawing up development plans. In Pakistan's second five-year plan the projected level of national income is taken as politically given, and a number of behaviouristic relationships are also assumed to be given, but foreign aid is treated as a variable which will adjust itself to the needs of the rest of the plan. The authors compare this with various other possible combinations of assumptions.]

## *South African*

HOUGHTON (D. HOBART) (Ed.). Economic Development in a Plural Society. Studies in the Border Region of the Cape Province. Cape Town and London: Oxford University Press, 1960. 10″. Pp. xv + 401. 60*s.*

[To be reviewed.]

## *American*

AHMAD (J.). Natural Resources in Low Income Countries. An analytical survey of socio-economic research. Pittsburgh, Ohio: University of Pittsburgh Press, 1960. 11″. Pp. xxi + 118. $2.50.

[This is a classified bibliography of the work so far done on the subject. The 502 items included are drawn from a wide range of sources, and many of them are of the official or semi-official kind that tend to elude conventional library classifications. The title of each item is followed by a fairly full summary of its contents. There is a general introduction surveying the field as a whole.]

ALLEN (R. L.). Soviet Economic Warfare. Washington, D.C.: Public Affairs Press, 1960. 9½". Pp. x + 293. $5.00.

[To be reviewed.]

BACH (G. L.). Economics. An introduction to analysis and policy. Third edition. Englewood Cliffs, New Jersey: Prentice-Hall, 1960. 9½". Pp. xiv + 850.

[This is a very substantially revised edition of one of the best-known American text-books.]

BAKKE (E. W.), KERR (C.). and ANROD (C. W.). Unions, Management, and the Public. Second edition. New York: Harcourt, Brace, 1960. 9½". Pp. xviii + 650. $6.50.

[This is the second edition, greatly altered, of a work which first appeared in 1948. The authors explain that they planned the structure of the book and the chapter headings as they would have done had they set out to write a systematic text-book themselves; but they then made each chapter consist of extracts from the writings of leading authorities in the part of the field concerned. The result is a selection of 141 readings, arranged in a logical order, with introductions to each chapter by the editors to indicate the nature of the issues under discussion and their context.]

BELL (J. W.) and SPAHR (W. E.) (Eds.). A Proper Monetary and Banking System for the United States. New York: The Ronald Press, 1960. 8½". Pp. viii + 239.

[This is the joint work of the following group of authors: J. W. Bell, F. A. Bradford, D. L. Kemmerer, F. R. Niehaus, M. Palyi, R. T. Patterson, C. W. Phelps, W. E. Spahr and G. C. Wiegand. These authors share the same general attitude to monetary problems, and they here put forward proposals for reforms which would get rid of what they consider to be the present grave faults of American monetary policy. Chief of these faults are " the departure by our Federal government from the integrity of a redeemable currency; the use by our central government of the Federal Reserve System and commercial banks to finance activities by devices favourable to itself . . .; the pronounced depreciation of the purchasing power of the United States dollar; and the persistent agitation for another devaluation of the dollar."]

BRAZER (H. E.). A Program for Federal Tax Revision. Michigan Pamphlets No. 28. Ann Arbor, Michigan: Institute of Public Administration, University of Michigan, 1960. 8½". Pp. 50. $1.50.

[This is a brief and well-argued statement of a comprehensive programme for rationalising the federal tax structure and eliminating the more serious anomalies and inequities which it now contains. The author is particularly concerned with the growth of concessions of one sort or another which serve to erode the tax base.]

BREDO (W.). Industrial Estates: tool for industrialization. Glencoe, Illinois: The Free Press for the International Industrial Development Center, Stanford Research Institute, 1960. 9". Pp. xvi + 240. $6.00.

[This study is designed especially for planners in newly industrialising countries who have responsibility for the development of small- and medium-scale industrial enterprises. Industrial estates, which are familiar in this country as an instrument of location policy, have played an important part in industrialisation in Puerto Rico and have now been adopted as part of the Indian programme to encourage small-scale industry. Dr. Bredo has brought together a great deal of useful information from the experience of many countries. He deals with questions of organisation, siting, design, finance and so on, looked at from the practical point of view rather than as an academic study.]

BRYCE (M. D.). Industrial Development. A guide for accelerating economic growth. New York and London: McGraw-Hill, 1960. 9½". Pp. xvi + 282. 58s.

[To be reviewed.]

CLARK (J. M.). The Wage-Price Problem. New York: The American Bankers Association, 1960. 9½". Pp. vi + 68.

[In 1959 the American Bankers Association launched a long-range programme to promote economic growth and to combat inflation. They succeeded in persuading Professor J. M. Clark to write for them this monograph. Professor Clark has produced a very valuable simple statement of the underlying problems of securing that money incomes rise only in proportion to the increase of real wealth produced. He explains clearly the difficulties of changing differentials and of the unsatisfactory consequences for differentials of wages designed to reflect increases of productivity in particular industries. He ends with a discussion, naturally in terms of the American background, of possible forms of organisation that might contribute to a more satisfactory wage and distribution policy. The outcome is somewhat too similar to that of the original concept of the Cohen Council for most English readers to feel great confidence in its full efficacy without a very strong fiscal policy behind it.]

DAVIDSON (P.). Theories of Aggregate Income Distribution. New Brunswick, New Jersey: Rutgers University Press, 1960. 9″. Pp. x + 151. $5.00.
[To be reviewed.]

DERNBURG (T. F.) and MCDOUGALL (D. M.). Macro-economics. The measurement, analysis and control of aggregate economic activity. New York and London: McGraw-Hill, 1960. 9½″. Pp. x + 267. 50*s*. 6*d*.
[To be reviewed.]

EELLS (R.). The Meaning of Modern Business. An introduction to the philosophy of large corporate enterprise. New York: Columbia University Press (London: Oxford University Press), 1960. 9½″. Pp. xi + 427. 60*s*.
[To be reviewed.]

FOURASTIÉ (J.). The Causes of Wealth. Translated and edited by T. CAPLOW. Glencoe, Illinois: The Free Press, 1960. 8½″. Pp. 246. $5.00.
[To be reviewed.]

FRIEDMAN (M.). A Program for Monetary Stability. New York: Fordham University, 1960. 9½″. Pp. viii + 110. $2.75.
[To be reviewed.]

GALE (D.). The Theory of Linear Economic Models. New York and London: McGraw-Hill, 1960. 9½″. Pp. xxi + 330. 74*s*.
[To be reviewed.]

GALENSON (W.). The CIO Challenge to the AFL. A History of the American Labor Movement, 1935–41. Cambridge, Mass.: Harvard University Press (London: Oxford University Press), 1960. 9½″. Pp. xx + 732. 78*s*.
[To be reviewed.]

HALL (C. A.). Fiscal Policy for Stable Growth. A study in dynamic macroeconomics. New York: Holt, Rinehart and Winston, 1960. 8½″. Pp. vii + 311. $5.00.
[To be reviewed.]

HARBERGER (A. C.) (Ed.). The Demand for Durable Goods. Chicago, Illinois: Chicago University Press (London: Cambridge University Press), 1960. 9″. Pp. vi + 274. 48*s*.
[To be reviewed.]

KARP (M.). The Economics of Trusteeship in Somalia. Boston University African Research Series, No. 2. New York: New York University Press, 1960. 8½″. Pp. x + 185. $4.50.
[To be reviewed.]

KNIGHT (F. H.). Intelligence and Democratic Action. Cambridge, Mass.: Harvard University Press (London: Oxford University Press), 1960. 8½″. Pp. vi + 177. 30*s*.
[To be reviewed.]

KUZNETS (S.), MILLER (ANN R.) and EASTERLIN (R. A.). Population Redistribution and Economic Growth, United States 1870–1950. Volume II: Analyses of Economic Change. Philadelphia, Pennsylvania: The American Philosophical Society (104 South Fifth Street, Philadelphia 6), 1960. 12″. Pp. xiv + 289. $5.00.
[To be reviewed.]

LEIBENSTEIN (H.). Economic Theory and Organizational Analysis. New York: Harper & Brothers, 1960. 8½″. Pp. x + 349. $6.00.
[To be reviewed.]

LONG (C. D.). The Labor Force under Changing Income and Employment. Princeton, New Jersey: Princeton University Press for the National Bureau of Economic Research, 1958 (London: Oxford University Press, 1959). 9″. Pp. xxiv + 439. 80*s*.
[To be reviewed.]

Long-range Projections for Economic Growth. The American Economy in 1970. Washington, D.C.: National Planning Association, 1959. Pp. viii + 96. $2.00.

[The projections herein contained are optimistic ones and show a compound interest rate of growth of gross national product of 4·2%. The reasons for this optimism are stated in rather general terms, with reference to the increased tempo of research and the retarding influences exerted in the past by depressions, which in the future governments may be expected to prevent.]

MARCSON (S.). The Scientist in American Industry. Some organizational determinants in manpower utilization. Princeton, New Jersey: Industrial Relations Section, Princeton University, 1960. 8½". Pp. 158.

[The author is professor of Sociology at Rutgers University. He undertook a field study on the organisation of research and the working environment of scientists in a large corporation. In this monograph he analyses the career development of scientists in the corporation, the stresses they are exposed to and the fundamental problem of authority. He argues that scientists do not easily accommodate themselves to the pattern of authority that is normal elsewhere in the corporate enterprise. He suggests that a proper blending is needed of "executive authority" of the usual sort and of what he calls "colleague authority," which is the sort of professional independence, within limits, enjoyed by university staff.]

MARTIN (D. D.). Mergers and the Clayton Act. Berkeley, California: University of California Press, 1959 (London: Cambridge University Press, 1960). 9¼". Pp. xii + 351. 48s.

[To be reviewed.]

NATIONAL BUREAU OF ECONOMIC RESEARCH. A respect for Facts, by SOLOMON FABRICANT. 40th Annual Report. New York: National Bureau of Economic Research (261 Madison Avenue, New York 16), 1960. 10½". Pp. viii + 72.

[This report contains, as usual, a full description of the National Bureau's current activities, and gives substantial and informative summaries of the provisional findings of work in progress. In his introductory essay Mr. Fabricant takes the title phrase as his text in presenting an overall view of the National Bureau's current work and aims.]

NELSON (R. L.). Merger Movements in American Industry 1895–1956. Princeton, New Jersey: Princeton University Press for the National Bureau of Economic Research, 1959 (London: Oxford University Press, 1960). 9¼". Pp. xxi + 177. 40s.

[To be reviewed.]

NORTON (F. E.) and JACOBY (N. H.). Bank Deposits and Legal Reserve Requirements. Los Angeles, California: Graduate School of Business Administration, University of California, 1960. 9¼". Pp. xiv + 139.

[The authors have made a sample study of the relationships between various characteristics of banks in the United States (size, location, form of organisation) and the structure and behaviour of their deposits. Their researches also include a similar comparison between branch banks and unit banks. The object of these inquiries is to suggest a fairer and more effective structure of legal reserve requirements than exists at present. The system which the authors favour, at least on theoretical grounds, is one by which banks would be divided into categories according to the rate of turnover of their deposits, and the legal reserve ratios differentiated accordingly. They also consider some other schemes, which though cruder would still be an improvement on present arrangements. Despite its technical nature, this monograph raises some interesting questions in the theory of banking and monetary control.]

PESSEMIER (E. A.). The Management of Grocery Inventories in Supermarkets. Pullman, Washington: Bureau of Economic and Business Research, State College of Washington, 1960. 9". Pp. viii + 192. $2.00.

[This describes and analyses current practices and proposed alternatives. The concluding chapter is designed to provide a practical and self-contained inventory control manual for store managers and their assistants.]

Population Trends in Eastern Europe, the U.S.S.R. and Mainland China. Proceedings of the thirty-sixth annual conference of the Milbank Memorial Fund. New York: Milbank Memorial Fund, 1960. 9". Pp. 334.

[This contains the proceedings of a conference held in November 1959. Those contributing papers were Jerry W. Combs, John F. Kantner, Warren F. Eason, John S. Aird, Leo A. Orleans, Alexander Eckstein, W. Parker Mauldin, Demitri B. Shimkin, Irene B. Taeuber and Nai-chi Wang. F. Lorimer, F. W. Notestein and other leading demographers took part in the discussions.]

Proceedings, International Conference on Control of Restrictive Business Practices. Glencoe, Illinois: The Free Press for the Graduate School of Business, University of Chicago, 1960. 8½". Pp. xix + 380. $10.00.

[To be reviewed.]

RAPKIN (C.) and GRIGSBY (W. G.). The Demand for Housing in Eastwick. Prepared for the Redevelopment Authority of the City of Philadelphia. Philadelphia, Pennsylvania: Institute of Urban Studies, University of Pennsylvania, 1960. 9". Pp. xii + 83. $2.00.

[Eastwick is a large area in Philadelphia scheduled for redevelopment. This is an attempt to estimate what the demand is likely to be for housing there at various possible prices. In addition to the usual considerations about size and growth of population, distance from places of work and so on, which take up most of the authors' space, an interesting element in these calculations is the interaction of demand between whites and non-whites. If prices are fixed low, demand from non-whites is stimulated, but the presence of non-whites lessens demand from whites, so the net result is likely to be that a low price lessens total demand, unless the whites' own price-elasticity of demand for housing is sufficiently high.]

ROSTOW (E. V.). Planning for Freedom. The public law of American capitalism. New Haven, Connecticut: Yale University Press, 1959 (London: Oxford University Press, 1960). 9½". Pp. xii + 437. 48*s*.

[To be reviewed.]

SCHELLING (T. C.). The Strategy of Conflict. Cambridge, Mass.: Harvard University Press), 1960. 8½". Pp. vii + 309. 50*s*.

[To be reviewed.]

SHOUP (C. S.) and others. The Fiscal System of the Federal District of Venezuela. A report. New York: 1960 (published privately). 9½". Pp. x + 162.

[To be reviewed.]

Small Industry. An international annotated bibliography compiled by M. C. ALEXANDER-FRUTSCHI. Glencoe, Illinois: The Free Press for the International Industrial Development Center, Stanford Research Institute, 1960. 9". Pp. xviii + 218. $10.00.

[This carefully compiled selective bibliography lists over a thousand items, with informative summaries of contents. They are well classified and indexed. Particular emphasis is given to items that cast light on the role that small firms can play in the industrialisation process, but this does not prevent a very ample coverage being given to the literature on small businesses in advanced countries as well.]

STEIN (M. R.). The Eclipse of Community. An interpretation of American studies. Princeton, New Jersey: Princeton University Press (London: Oxford University Press), 1960. 9". Pp. xii + 354. 48*s*.

[To be reviewed.]

STEPANEK (J. E.). Small Industrial Advisory Services. An international study. Glencoe, Illinois: The Free Press for the International Industrial Center, Stanford Research Institute, 1960. 9". Pp. xiv + 193. $6.00.

[This is a practical study, written by an author with wide experience in industry in underdeveloped countries. It contains much information and advice on the best ways to organise these services, based on the author's own experience and on the literature of the subject.]

TAYLOR (O. H.). A History of Economic Thought. New York and London: McGraw-Hill, 1960. 9". Pp. xix + 524. 60*s*.

[To be reviewed.]

THEOBALD (R.). The Rich and the Poor. A study of the economics of rising expectations. New York: Clarkson N. Potter, 1960. 8½". Pp. xii + 195. $4.50.

[To be reviewed.]

TRIFFIN (R.). Gold and the Dollar Crisis. The future of convertibility. New Haven, Connecticut: Yale University Press (London: Oxford University Press), 1960. 9½". Pp. xiii + 195. 38*s*.

[To be reviewed.]

ULMER (M. J.). Capital in Transportation, Communications, and Public Utilities: Its Formation and Financing. Princeton, New Jersey: Princeton University Press for the National Bureau of Economic Research (London: Oxford University Press), 1960. 9¼". Pp. xxxviii + 548. 96*s*.

[To be reviewed.]

## *Dutch*

FOG (B.). Industrial Pricing Policies. An analysis of pricing policies of Danish manufacturers. Amsterdam: North-Holland Publishing Company, 1960. 9". Pp. viii + 229. 35*s*.

[To be reviewed.]

JOHANSEN (L.). A Multi-sectoral Study of Economic Growth. Contributions to Economic Analysis, XXI. Amsterdam: North-Holland Publishing Company, 1960. 9". Pp. 177.

[To be reviewed.]

LEVY (M. E.). Income Tax Exemptions. An analysis of the effects of personal exemptions on the income tax structure. Amsterdam: North-Holland Publishing Company, 1960. 9". Pp. xii + 148.

[This is based on a doctoral dissertation at Columbia University. In it the author carefully analyses the effects of alternative schemes of tax exemption and tax-rate changes on the average rate of tax, on tax progresaivity and on incentives.]

RÖPKE (W.). International Order and Economic Integration. Dordrecht: Reidel, 1960. 9". Pp. viii + 276. D. fl. 22.50.

[To be reviewed.]

WIJNHOLDS (H. W. J.). The Budget Theory of Money. Amsterdam: The Academic Press (151 Warmoesstraat), 1960. 9". Pp. 227.

[This is mainly designed as a general text-book on the theory of money, including a description of the various types of money, the history of monetary systems, the relation between money and the price level and the theory of the foreign exchanges. The author is aware that a text-book written on these lines may appear to many readers rather old-fashioned, and he devotes an introductory chapter to answering this charge. Most of the book follows straightforward lines. In his treatment of effects of change in the quantity of money, however, the author follows a line of his own, and it is from this that the book takes its title. He draws a distinction between the quantity of money and the "possesion of money," the latter being apparently calculated after allowance for changes in other assets or liabilities. The terminology used is not wholly clear, and "money" sometimes seems to bear its normal meaning and sometimes to mean the whole of an individual's assets. The conclusions drawn from the theory emphasise the importance of fiscal policy.]

## *Danish*

HENRIKSEN (O. B.) and ØLGAARD (A.). Danmarks Udenrigshandel 1874–1958. Copenhagen: Institute of Economics, University of Copenhagen (Studiestraede 6, Copenhagen K), 1960. 10". Pp. 133.

[This is a collection of statistics relating to the development of Danish foreign trade since 1874. The headings and notes to the tables are given in English as well as in Danish. A short introduction in English comments on some of the trends revealed.]

## *Swedish*

ÅKERMAN (J.). Theory of Industrialism. Causal analysis and economic plans. Lund Social Science Studies, No. 19. Lund: Gleerup, 1960. 9¼". Pp. 332. Sw. kr. 25.

[To be reviewed.]

NORR (M.) and SANDELS (C.). The Corporate Income Tax in Sweden. Stockholm: Stockholms Enskilda Bank, 1960. 8¼". Pp. 60.

[This is a brief survey designed for the use of those who contemplate doing business in or with Sweden.]

## *Italian*

SYLOS-LABINI (P.). Economie capitalistiche ed economie pianificate. Bari: Editori Laterza, 1960. 8″. Pp. 246. L. 2000.

[To be reviewed.]

## *Japanese*

ISLAM (NURUL). Foreign Capital and Economic Development, Japan, India, and Canada. Studies in some aspects of absorption of foreign capital. Tokyo and Rutland, Vermont: Charles E. Tuttle Company (15 Edogawacho, Bunkyo-ku, Tokyo), 1960. 8½″. Pp. 254. $5.00.

[To be reviewed.]

## *Rumanian*

RICARDO (D.). Opere Alese, Vol. I. Bucarest: Academia Republicii Populare Romine, 1959. 9½″. Pp. 333.

[This is a Rumanian edition of Ricardo's *Principles*. The translation does not appear to be based directly on Mr. Sraffa's edition, but the long introduction by C. Murgescu on "David Ricardo—A Classic of Bourgeois Political Economy" contains extensive references to the materials in that edition.]

## *Official*

### BRITISH

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD. Domestic Food Consumption and Expenditure, 1958. Annual Report of the National Food Survey Committee. London: H.M. Stationery Office, 1960. 9½″. Pp. vii + 185. 10*s*.

[The main part of this annual report follows the usual form, and provides data on the diets of households of different income levels and family composition. A new feature is that for the first time demand-analysis based on time-series is undertaken to give estimates of price- and income-elasticities of various foodstuffs. The methods used are those developed by J. A. C. Brown. Income-elasticity of demand is found to be generally lower than it was before the War, whereas price-elasticities in many cases turn out to be quite high.]

### SOUTH AFRICAN

A Survey of Rent-paying Capacity of Urban Natives in South Africa. A report of the Committee on Socio-economic Surveys for Bantu Housing Research. Pretoria: South African Council for Scientific and Industrial Research, 1960. 9″. Pp. xvi + 123.

[This records the findings of a sample survey. Data are given on the age- and sex-compositions of native households in a number of towns, and inferences are drawn as to the type of accommodation required (hostel, one-room, two-room, etc.). A comparison is then made between incomes and the cost of what are reckoned to be "necessary" purchases of food and other items, so as to yield the margin available for paying rent. It turns out that on the basis chosen, a large proportion of households have a zero or negative margin available. The authors therefore recommend that extensive provision of subsidised housing is needed, with rents discriminating according to means. While the data collected are useful and interesting, any economist reading the report is bound to feel doubts about the assumptions underlying the policy recommendations and about the implicit doctrine that housing is necessarily to be treated as the residual item which is to receive whatever subsidy is necessary to prevent people falling below the poverty line.]

### AMERICAN

Treasury-Federal Reserve Study of the Government Securities Market. Part I: Report on Consultations; An Organized Exchange or a Dealer Market; 1959; pp. 108. Part II: Factual Review for 1958; 1960; pp 159. Part III: Supplementary Studies; 1960; pp. 112. Washington, D.C.: Federal Reserve System. 9″.

[These three small volumes constitute a *post-mortem* on the collapse of the Government security market in the United States in mid-1958. Part I consists of a general report on the consultations conducted by the joint Treasury-Federal Reserve study group, together with a special study on the merits of an organised exchange for Government Securities. Part II is a detailed factual study of the Government securities market in 1958 and Part III contains some supplementary studies on such matters as margin requirements. Although principally of interest to the specialist, all three volumes manage to combine the qualities of analytical competence and simplicity of presentation.]

EUROPEAN COAL AND STEEL COMMUNITY. Eighth General Report on the Activities of the Community. Luxemburg: European Coal and Steel Community, 1960. 9". Pp. 456.

[This report contains a chapter on supply and demand for energy within the Community countries, as well as a full account of the activities of the Community itself during the year.]

INTERNATIONAL LABOUR OFFICE. Job Evaluation. Geneva: International Labour Office, 1960. 9½". Pp. 146. 7*s.* 6*d.*

[This publication both discusses the functions and usefulness of job evaluation and provides an outline account of the methods it uses, with reference to experience in a number of particular cases. The authors' general attitude to the economic background of the subject is a sensible one, viz., that, whether rightly or wrongly, people have a deeply-rooted idea that as a matter of "fairness" wages should bear some relation to the characteristics of the job; that this is bound to be *one* of the considerations affecting relative wages, though not necessarily the most important one; and that in view of this it is useful to have these characteristics measured as scientifically as possible.]

ORGANISATION FOR EUROPEAN ECONOMIC CO-OPERATION. Europe and the World Economy. Eleventh Annual Economic Review. Paris: O.E.E.C., 1960. 9½". Pp. 138. 9*s.*

[This extremely useful succinct review deals with developments in 1959. Special features include a chapter on recession and recovery in individual industries, with particular attention to industries that are not sharing in the general buoyancy of the European economy. More than half of the review deals with the external trade and payments of member countries, and it is suggested that it would now be appropriate for industrial countries to act together to provide increased outlets for the products of less-developed countries.]

UNITED NATIONS. Economic Survey of Asia and the Far East 1959. Bangkok: United Nations, 1960. 11". Pp. xii + 169. 21*s.*

[Part I of this report gives a preliminary view of the economic situation in the region in 1959. Part II is devoted to a review of foreign trade in the primary exporting countries in the region, including long-term trends (1928–57) and future prospects and problems.]

UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANISATION. International Bibliography of Economics, Vol. VII. Paris: UNESCO, 1960. 9½". Pp. 528. 53*s.* 6*d.*

[This contains a classified unannotated list of the titles of 8379 books or articles published in 1958. All countries and languages are included. How far does this gigantic compilation, and the series of which it is a part, go towards providing the documentation service that economists require? There is no doubt that it is a tremendously valuable source of reference, and its weaknesses are largely due to the scale on which it is planned. Thus the delay between the period covered and publication is by no means unreasonable in view of its size, but it is still enough to prevent it from serving to keep economists systematically abreast with the latest work. Similarly, although the system of classification and indexing makes it easy to find items dealing with a well-defined field in applied economics, such as a particular industry or country, it is much more difficult to find the items that matter in economic theory, especially since a considerable proportion of those listed are in languages like Japanese that make them inaccessible to most readers. In sum, this is a most useful piece of work, but its existence should not be taken as an argument against pressing on with efforts to secure a truly up-to-date documentation service, preferably quarterly, with abstracts.]

UNITED NATIONS FOOD AND AGRICULTURE ORGANIZATION. The Economic Role of Middlemen and Co-operatives in Indo-Pacific Fisheries. Vol. I, edited by E. F. SZCZEPANIK. Rome: F.A.O., 1960. 9". Pp. viii + 133. 7*s.* 6*d.*

[This volume is one of a series dealing with the general subject indicated in the title. It contains two separate essays, the first, by M. B. Desai and P. R. Baichwal, on the fishing industry in Thana District, Bombay State, and the second, by E. F. Szczepanik, on the fishing industry in Hong Kong. Both essays contain general surveys of the fishing industry in the places concerned as well as of the particular problems of marketing and co-operatives.]

UNITED NATIONS FOOD AND AGRICULTURE ORGANIZATION. Production Yearbook, Vol. 13, 1959. Rome: F.A.O., 1960. 11". Pp. xii + 484. 25*s.*

UNITED NATIONS FOOD AND AGRICULTURE ORGANIZATION. Trade Yearbook 1959, Vol. 13. Rome: F.A.O., 1960. 11". Pp. xvii + 349. 17*s.* 6*d.*

[These two complementary volumes of statistics follow similar lines to previous issues in their series.]

## The Economics of Shipbuilding

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